FISHERY MANAGEMENT INVESTIGATIONS

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ANDERSON RANCH RESERVOIR

ABSTRACT

We assessed the kokanee *Oncorhynchus nerka* population in Anderson Ranch Reservoir (ARR) during June 2012. Using trawl-based techniques, total kokanee abundance for all strata and age groups combined was 7,671,738 fish, representing a density of 4,968 fish/ha. Densities of age-0, 1, 2, and 3 kokanee were estimated at 4,117, 777, 72, and 3 fish/ha, respectively. Estimated biomass for all strata and age groups combined was 67.65 kg/ha. Using hydroacoustic techniques abundance of fry and age 1-3 fish combined was 1,779,258 (90% CI, ± 246,387) and 2,364,383 (90% CI, ± 472,462), respectively. The abundance of all kokanee was estimated at 4,143,641 fish (90% CI, ± 679,787). These two methods led to relatively large differences in point estimates; regardless, both estimates are indicative of very high abundance and density.

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INTRODUCTION

Anderson Ranch Reservoir (ARR) is a Bureau of Reclamation (BOR) impoundment of the South Fork Boise River in Elmore County. ARR has a maximum reservoir storage capacity of 60,833 hectare meters, with 3,575 hectare meters considered dead storage (USGS 1996). ARR supports popular fisheries for kokanee *Oncorhynchus nerka* and Smallmouth Bass *Micropterus salmoides*. Rainbow Trout *O. mykiss* and Yellow Perch *Perca flavescens* are considered secondary target species and are often caught incidentally. Bull Trout *Salvelinus confluentus* and several other nongame fish species are also present, but provide little recreational angling opportunity in the reservoir.

Kokanee in ARR are managed to provide a harvest-oriented fishery with current regulations allowing 25 fish/day bag limit and 50 fish possession limit (IDFG Fisheries Management Plan 2007). Monitoring of ARR's kokanee population is completed annually using trawl-net sampling. In addition, beginning in 2011, kokanee population abundance estimates were generated with hydroacoustic techniques in an effort to provide a comparison to trawl-net data. This survey utilized both sampling strategies and was conducted to assess the kokanee population and determine whether alternate management strategies are needed. In addition, we collected information on Smallmouth Bass.

METHODS

Trawl Estimates of Kokanee Abundance

Kokanee surveys at ARR have been completed using nighttime trawling techniques described by Rieman (1992). Trawling was completed July 18th and 19th, 2012 during the new moon phase, when the reservoir was at 98% maximum capacity. At each transect, a 4.46-m^2 framed trawl net was towed at approximately 1.59 m/s for 180-s intervals. Trawls were stepped down at 3-m depth increments between 7.3 and 22 m. Seven trawls were completed per strata; which mimicked historical sampling efforts (Partridge and Warren 1995; Ryan et al. 2005; Ryan et al. 2007). Age-at-length data from trawl-caught kokanee was used in conjunction with target strength-frequency distributions to define age-class thresholds within hydroacoustic echogram data (Stark and Stockner 2006). However, trawl data collected for this study, suggested kokanee age-at-length distributions overlapped considerably; therefore, this evaluation used the known age proportions to define acoustic transects.

During 2012, the kokanee population was also assessed by conducting a lake-wide hydroacoustic survey. The hydroacoustic survey was completed during the night of August 3rd utilizing a 17' Boston Whaler boat. Kokanee abundances estimates were generated using a Simrad EK60 scientific echo sounder with a split-beam 120 kHz transducer. The echo sounder transducer was set at 0.5 m below the water's surface with a ping rate of 3.3 ping/s. Travel speed was 1.5 m/s. Simrad EK60 was calibrated using a 23-mm copper calibration sphere, with a target strength (TS) of -40.4 decibels (dB), with calibration settings being determined and input using Simrad ER60 software. Three previously established lake sections were used in the 2012 survey in order to maintain consistency with historical surveys: Lower (1) – 680 ha, Mid (2) – 590 ha, and Upper (3) – 394 ha (Figure 1).

Kokanee abundance estimates were calculated using Sonar Data Echo View software, version 5.0.78. Within the echogram, a box was drawn around the kokanee layer of each transect (on average, 5 to 55 m deep), integrated to obtain the nautical area scattering coefficient (NASC), and analyzed to obtain the mean TS of all returned echoes (Hardy et al. 2010). This integration accounted for fish that were too close together to detect as a single target (MacLennan and Simmonds 1992). Densities were then calculated by the equation:

$$\text{Density (fish/ha)} = (\text{NASC} / 4\pi 10^{TS/10})\ 0.00292$$

Where: NASC = total backscattering (m^2/nautical mile)
TS = mean target strength in dB for the area sampled

The target strength data from all returned echoes that qualified as single fish targets were binned into 1.0 dB intervals (adjusted target strength) for each transect. Single fish targets were categorized into kokanee or non-kokanee groups based upon their TS and the known range of kokanee total lengths from the trawl survey. All single targets less than -60.0 dB were considered too small to be kokanee fry. Targets greater than -32.0 dB were thought to be too large to be kokanee, and were most likely trout. The age structure of the kokanee population was described by examination of scales collected from trawl-caught kokanee. Kokanee were grouped into 10-mm bins, aged, and then proportioned to the total catch. Length were converted to approximate acoustic target strength bins (-1.0 dB) using Love's equation (1971). Acoustic fish targets were categorized into number of targets of each age using the aforementioned trawl-age proportions. For example, 83% of fish 285-305 mm (-35.9 to -35.0 dB) were age-2 kokanee and the remaining 17% were age-3 kokanee. These percentages were used to assign the number of each age per 1.0 dB bin in each acoustic transect.

Kokanee target strength between -60.0 dB (approximately 16 mm; Love 1971) and 43.0 dB (123 mm), were defined as kokanee fry. Fish targets between -42.9 and - 32.0 dB were defined as age 1 – 3 kokanee. Trawl age-at-length proportions resulted in age-1 target strengths from -42.9 to –38.0 dB (124-224 mm), age-2 from -39.0 to -34.0 dB (205 - 363 mm), and age-3 from -36.0 and -32.0 dB (305-462 mm).

Kokanee age class density estimates were completed for each hydroacoustic transect. The rate of age class targets for each transect were multiplied by the total transect volume. Kokanee abundance estimates by reservoir section were calculated by multiplying age class densities for each acoustic transect by the volume of reservoir in that section. The total kokanee population abundance estimate was calculated by summing all reservoir sections and age class abundance estimates.

RESULTS

Trawl Estimates of Kokanee Abundance

Kokanee catch per trawl averaged 113 ± 21 (95% CI) and ranged from 22 to 603. We completed the prescribed sampling effort (21 transects) resulting in a total catch of 4,426 kokanee. Kokanee lengths ranged from 40 to 330 mm (Figure 2). Total abundance of kokanee for all strata and age groups combined was estimated as 7,671,738 fish, representing a density of 4,968 fish/ha. Densities of age-0, 1, 2, and 3 kokanee in 2012 were estimated at 4,117, 777, 72, and 3 fish/ha, respectively. The standing crop estimate for 2012, among all strata and age groups was 67.65 kg/ha (Table 1). Mean length at age 2 and 3 also decreased in the 2012 sample as compared to 2010 and 2011 sampling efforts (Figure 3).

A non-random subsample of kokanee was collected and aged (*n* = 152). Otoliths were collected from at least ten fish from each 1-cm length group of kokanee greater than 100 mm. Kokanee less than 100 mm were classified as young-of-the-year. The average length within the subsample was 212 ± 55 (95% CI).

Hydroacoustic Estimates of Kokanee Abundance

A total of 50,446 echo returns were recorded from fish within the kokanee layer of all hydroacoustic transects. Fish target strengths from echo returns ranged between -60 to -29 dBs. Approximately 42% of kokanee targets had target strengths within the fry range. Both fry and age-1 – 3 densities were higher in the lower reservoir than in the middle reservoir (Table 2). We estimated a total of 1,779,258 ± 246,387 fry (90% CI) and 2,364,383 ± 472,462 age-1 – 3 fish (90% CI) in Anderson Ranch Reservoir (Table 3). The abundance of all kokanee was estimated at 4,143,641 ± 679,787fish (90% CI).

DISCUSSION

Population estimates of kokanee during 2012 were very high. Summed density (fish/ha) of kokanee combined for all age classes in 2012 was the highest ever recorded in Anderson Ranch Reservoir (Table 4). Such high density of kokanee will likely reduce growth and result in smaller sized adults. Our management objective is to provide a kokanee fishery with catch rates of one kokanee an hour with mean adult lengths of 305-356 mm. Based on signal strength and detection frequency, we expect fish size in the creel to be less than 305 mm (Figure 4).

Variation in kokanee abundance at Anderson Ranch Reservoir can be attributed to a multitude of factors, making effective management of this fishery quite challenging. Factors include reservoir storage levels, entrainment, adult escapement, spawning habitat conditions, and winter survival of deposited eggs. IDFG has little control over most of these factors; however, kokanee abundance can be manipulated when needed with harvest regulations, escapement management, or stocking.

Anderson Ranch Reservoir kokanee abundance has been estimated for many years; however, no correlations have been established between SFBR kokanee escapement, reservoir recruitment, and overall abundance. Ideally, SFBR kokanee escapement can be moderated in high potential recruitment years to reduce the likelihood of overabundance and reduced growth. The Department can operate a complete migration barrier weir to monitor and/or control kokanee escapement on the SFBR. To accomplish this goal, correlations should be established between escapement, year-class strength, growth, and catch rates to estimate the optimal escapement levels. Developing these correlations would need to include escapement or recruitment estimates from other tributaries as well, such as Lime Creek and Fall Creek. Both of these tributaries offer spawning habitat and are likely contributing to the overall kokanee recruitment into Anderson Ranch Reservoir. No controlled escapement with a weir took place on the South Fork Boise River in 2012 or in the several years prior.

Hydroacoustic Estimates of Kokanee Abundance

The total population estimate for kokanee in Anderson Ranch Reservoir decreased by about 9%, from roughly 4.6 million in 2011 to 4.1 million in 2012 (Table 4). However, densities increased nearly 20% from 2,755 kokanee/ha in 2011 to 3,263 kokanee/ha in 2012. In contrast to

2011, all of the increase in kokanee abundance in 2012 was for age 1-3 abundance (+167%). Conversely, fry abundance decreased by about 52% from 2011.

Overall kokanee survival was approximately 52% during 2012 (August, 2011 – July, 2012). We could expect about 60% annual survival rates for a population with little or no predation (Maiolie and Elam 1995). However, this low survival is not too troubling since abundance of all ages remains very high. Survival rates for ages 1-3 were not estimated in 2013 since true age class abundances were not estimated. Yet, if we apply the average 2006-2012 age-1 survival rate of 27% (via trawl), to the 2013 fry abundance estimate, we could expect over 480,000 age-1 fish by August of 2014. Similarly high abundances of age-2 and age-3 kokanee would be expected in 2014, even with poor survival rates. Therefore, full escapement and spawning of adult kokanee during the fall of 2013, in conjunction with current high abundance of remaining ages, will continue to result in extremely high kokanee densities in Anderson Ranch Reservoir during 2014.

Allowing full adult escapement into the South Fork Boise River (not utilizing a temporary weir) likely lead to high fry production in 2011 and 2012. Conducting annual trawl and hydroacoustic surveys to estimate kokanee densities is important for gaining further understanding of this population. In addition, annual standardized creel surveys should be conducted to monitor angler catch, kokanee growth, kokanee size and angler success and satisfaction.

RECOMMENDATIONS

1. Monitor Anderson Ranch Reservoir kokanee abundance annually using both trawl and hydroacoustic techniques.

HAGERMAN WILDLIFE MANAGEMENT AREA

ABSTRACT

Manual Common Carp *Cyprinus carpio* suppression efforts were completed at Anderson Pond 1 and 2 at the Hagerman Wildlife Management Area (WMA) in the spring of 2012 and were deemed unsuccessful. Consequently, Anderson Pond 1 and 2 were drained, dredged (deepened), and treated with rotenone in the summer of 2012. Following rotenone treatment efforts in August 2012, approximately 1,100 Bluegill *Lepomis macrochirus* greater than 127 mm were translocated and released in Anderson 1 and 2 ponds.

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INTRODUCTION

Hagerman Wildlife Management Area (WMA) was initially developed in the 1940s and now includes a series of 16 ponds and associated dikes, dams, and canals. The primary focus of the Hagerman WMA is to provide refugia for migratory waterfowl; however, several ponds provide angling opportunities. Ponds receive substantial fishing use due to the proximity of several Magic Valley communities. The aquatic habitat created by Hagerman WMA ponds (hereafter ponds) is suitable for both cold water and warm water fish species depending on spring inflow and distance from spring heads. The ponds are shallow with mean depths of approximately 1 m and maximum depths of 2.0-2.5 m. Water is supplied from Brailsford Ditch (Len Lewis Spring), Big Bend Ditch (Tucker Springs), and Riley Creek (approximately 17 springs flowing from the escapement above the Hagerman National Fish Hatchery). All ponds are characterized by muck (decaying organic matter) bottoms which, during the summer, support extensive algae growth. Overhanging vegetation from trees and shrubs is common.

Historically, the Hagerman WMA provided some of the best Largemouth Bass *Micropterus salmoides* and Bluegill *Lepomis macrochirus* fishing opportunities in the Magic Valley Region. The Bass Ponds, Anderson Ponds 1 - 4, as well as the West Highway Pond all provided unique small pond fisheries. Angler effort surveys completed in the early 1980s showed high angler use and satisfaction (Grunder et al. 1986). In the mid to late 1990s, the fishery declined following the establishment of Common Carp *Cyprinus carpio* (Ryan et al. 2003). Common Carp are native to Asia, and in North America are known to alter water quality, reduce primary productivity, and severely impact warm water fisheries (Weber and Brown 2009).

In 2011, IDFG initiated a multifaceted approach to try to improve this fishery and understand the hydrology of ponds on the Hagerman WMA. Efforts included conducting an angler creel survey for comparison to the 1980s survey. Staff inventoried water movement, investigated potential carp movement barriers between ponds, evaluated fish species composition in each pond, and estimated the collective cost of providing this fishery. Results indicated that Hagerman WMA was still a popular community fishery, but angler satisfaction, catch rates, and effort had declined from the 1980s (Megargle et al. 2011). The cost associated with IDFG stocking hatchery Rainbow Trout *Oncorhynchus mykiss* in WMA ponds was approximately $40,000 based on the average annual stocking of 51,000 trout/year. Common Carp were widespread and composed most of the fish biomass in most ponds. Several potential movement barriers were identified.

Based on the cost/benefit analysis, historic and recent creel data, as well as current species composition at Hagerman WMA, staff sought to suppress or extirpate carp in Anderson Ponds 1 and 2 with manual or chemical methods.

OBJECTIVE

The objectives of this study were to: 1) complete inventory, assessment, and mapping of hydrologic features of ponds and associated infrastructure on the Hagerman WMA, 2) suppress or extirpate Common Carp from the Hagerman WMA ponds, and 3) rebuild the warm water fishery.

STUDY AREA

The Hagerman WMA is located in Gooding County, along Highway 30, south of the town of Hagerman, Idaho. Hagerman WMA is 356 hectares. The Hagerman WMA includes the Hagerman State Fish Hatchery and sixteen ponds including 6-Oster Lakes, 4-Anderson Ponds, 2-Bass ponds, 1-Goose Pond, 1-Riley Creek Impoundment, 1-Hatchery Settling Pond and 1-West Pond. The water supply for the ponds is Brailsford Ditch (Len Lewis Spring), Big Bend Ditch (Tucker Springs), and Riley Creek (approximately 17 springs flowing from the escapement above the Hagerman National Fish Hatchery). Spring water is 58º F at its source.

The Oster Lakes and Anderson Ponds are popular fisheries for trout, bass, and Bluegill. Most of the ponds to the north of the state fish hatchery are managed primarily for warm water fish, while the ponds to the south are managed as put-and-take trout fisheries. The Riley Creek Impoundment is the only pond north of the hatchery that is regularly stocked with trout.

Because of the WMA's importance as a waterfowl resting area during the winter and nesting area during the spring, the fishing season on the Anderson Ponds, Goose Pond, and West Pond is open from July 1 to October 31. All other waters on the WMA are open from March 1 to October 31, except Riley Creek upstream of the state fish hatchery diversion which is open to fishing year-round.

METHODS

Mechanical Carp Suppression

In spring 2012, Anderson Ponds 1 and 2 were drawn down to approximately 50 percent capacity. Due to existing impoundment infrastructure, the ponds could not be drained completely. We used trap nets and boat electrofishing to capture and remove common carp. A total of four trap nets (baited with corn) were soaked for 10 h a night, for four consecutive nights. Electrofishing efforts utilized pulsed DC (60 Hz, and 24% Duty Cycle) electricity at maximum output. Electrofishing efforts occurred for four nights at each pond; for a total of 10 h of power-on effort (5 h at each Anderson Ponds 1 and 2).

Rotenone Application

Prior to rotenone treatment efforts, all water control structures, potential barriers, and pond inflows and outflows for the Goose, Bass, and Anderson ponds were inventoried. Approximate location of infrastructure and control structures was determined using satellite imagery (Google Earth Pro©). Subsequently, staff surveyed these locations to assess structures. A GPS unit was used to mark each structure's location and to allow comparison with satellite imagery. Once the inventory was completed, a map was produced depicting hydrology for the Hagerman WMA (Figure 5).

Anderson Ponds were drawn down during the spring of 2012. Water delivery to the treatment area was shut off, and outflow structures were lowered. Shortly thereafter, only standing water was present (Figure 6). Additionally, pond dredging efforts were initiated to create deeper ponds for better angling opportunity post treatment and to concentrate fish in deep pools for more efficient chemical treatment.

Staff adhered to guidelines outlined in the Planning and Standard Operating Procedures for the Use of Rotenone in Fish Management (Finlayson et al. 2010). Synpren® fish toxicant was used to treat both ponds. Fish toxicant was applied with back pack sprayers. Also, dough balls laced with rotenone-adhered sand were placed in the stream inflow of Anderson Pond 1 (Finlayson et al. 2010).

Application rates were used for carp in organic rich environment. Nine gallons of Synpren ® Fish Toxicant (2.5% rotenone) were used (Table 5). Total treatment volumes ranged from 0.8 to 6 acre-feet with evaporation, water table, precipitation, and downstream impoundments all influencing existing pond volumes; therefore, final application rates (total volume and total product needed) were determined two days prior to actual treatment. Licensed professional applicators handled the piscicide mixing process. The mixing zone was isolated and staff used the appropriate Personal Protective Equipment (PPE) as required by product label and recommended by Finlayson et al. (2010).

The ponds had little to no outflows at the time of treatments. Anderson Pond 1 drains into Anderson Pond 2, so no detoxification was warranted. Anderson Pond 2 is potentially connected to a downstream impoundment on Riley Creek. Detoxification (potassium permanganate) contingencies (drip station) were planned, but were not implemented. The water control structure between Anderson Pond 2 and Riley Creek was sealed to prevent any rotenone treated water from escaping the treatment areas. Any rotenone treated water that seeped from Anderson Pond 2 was quickly diluted below minimum effective levels.

Sentinel fish were deployed in cages within the treatment area to determine treatment efficacy during the treatment period, and to monitor regular detoxification post treatment (Finlayson et al. 2010). Due to cage size restrictions and comparable toxicant susceptibility as carp, Bluegill were used as a surrogate. Each cage contained three Bluegill. Additionally, sentinel fish cages were deployed every 100 m downstream of Anderson Pond 2 outflow to monitor any unplanned release of toxicant into Riley Pond. Carcasses were quickly recovered and buried nearby to prevent animal scavenging and public exposure to toxicants, smell, and un-pleasurable aesthetics.

Ponds were filled from Brailsford/Riley ditch into Anderson Pond 1 after treatment, detoxification, and 100 percent sentinel fish survival (Finlayson et al. 2010). Screen barriers were installed on the outflow structures at Anderson Ponds 1 and 2 prior to post treatment pond filling to help prevent future carp invasions.

Bluegill Reintroduction

Bluegill translocations to Anderson Ponds 1 and 2 took place in September and October 2012, respectively. Fish were trap netted from the Goose Pond on the Hagerman WMA, and transported in tanks, by pickup truck to both Anderson Ponds 1 and 2. For Anderson Pond 1, a subsample (n = 50) of the Bluegill was measured for total length (mm) and weight (g). For Anderson Pond 2, a subsample (n = 100) of the Bluegill was measured for total length (mm) and weight (g). Staff intend to translocate Largemouth Bass here, after Bluegill spawn one or more times. Bass will be stocked in 2013 at 25% the density of 2012 Bluegill stocking densities (Soderberg and Swistock 1995).

RESULTS

Water Control Structures

Water control structures on the Hagerman WMA were located, inventoried, and modified to reduce the likelihood of carp immigration and establishment. Fifteen control structures were located and documented (Table 6). Three steel grate barriers were constructed (Figure 7) in locations where barriers were deemed insufficient to prevent carp establishment.

Mechanical Carp Suppression

Combined efforts (electrofishing and trap nets) yielded a catch and removal of 869 carp (59 in Anderson Pond 1, 810 in Anderson Pond 2). Despite 10 hours of shocking, catch of carp did not decline over time (i.e. no or little depletion). Based on the continued persistence of carp, mechanical removal efforts were deemed unsuccessful.

Rotenone Application

Chemical renovation of Anderson Ponds 1 and 2 was completed on August 22, 2012. Lethal concentrations were confirmed using sentinel fish captured prior to treatment. All fish residing within the cages were killed during the treatment suggesting lethal concentrations were achieved. Total treatment volumes and product used are shown in (Table 5).

Bluegill Reintroduction

Bluegill were translocated to Anderson Pond 1 on September 30; and Pond 2 on October 1, 2012. Full pool surface acreage of both Anderson Ponds 1 and 2 after treatment and refill was 9.5 and 11.0 acres, respectively. A total of 487 Bluegill were translocated into Anderson Pond 1. Stocking density was 51 Bluegill/acre in Anderson Pond 1. Total lengths from sampled fish ranged from 95 to 187 mm (Figure 8), and average total length was 143 mm (SD = 130); the average weight was 70 g (SD = 67). A total of 1,089 Bluegill were transplanted into Anderson Pond 2. Stocking density for Anderson Pond 2 was 99 Bluegill/acre. A subsample (n = 100) of the translocated Bluegill was measured for total length (mm) and weight (g). Total length ranged from 77-210 mm (Figure 9). Average total length was 126 mm (SD 120), and the average weight was 51 g (SD = 45).

DISCUSSION

This renovation was completed with the intention of extirpating Common Carp from the Hagerman WMA ponds. Extirpation of Common Carp would likely improve warm water fish populations and fisheries. Ultimately, a follow-up creel should occur after fish populations and fisheries have become re-established.

Improving understanding of the WMA's hydrology allowed development of an appropriate rotenone treatment plan, and identified possible points of future carp invasions. Further study of other portions of the WMA including Anderson Ponds 3 and 4 as well as West Highway Pond are needed. Common Carp are currently present in these ponds and future chemical treatments are being considered to eradicate Common Carp there. Carp are also present in Riley Pond and Oster Ponds 3-6.

Renovations of Anderson Ponds 1 and 2 resulted in total mortality of all fish present. Sentinel fish in Riley Pond downstream of the treatment area, remained alive throughout the four-hour treatment period and were still alive six hours after the treatment was completed. Therefore, we assume that no lethal or toxic concentration of rotenone resulted in fish mortality outside of the treatment area. The total treatment time was approximately 5 hours. No detoxification was used in the treatment. Treatment time to dispense all chemical lasted longer than planned or expected because only three backpack units were available to dispense product. Several unit-controlled battery pump sprayers should be used for future treatments. Follow-up monitoring via boat electrofishing on Anderson Ponds 1 and 2 will be completed during 2013 to determine whether initial determination of total mortality was accurate.

Re-establishing a desirable warm water fish community requires significant translocation efforts. The translocation target for Bluegill in both Anderson Ponds 1 and 2 was 100 adults/surface acre. This density was only achieved in Anderson Pond 2. Densities in Anderson Pond 1 were not achieved in the 2012. Additional translocation efforts may be necessary in future years, if carp eradication is deemed successful.

RECOMMENDATIONS

1. Consider rotenone treatment of other waters in the Hagerman WMA including Oster Lakes, Anderson Ponds 3 and 4, as well as West Pond to eradicate Common Carp.
2. Monitor density of Bluegill and other fishes in Anderson Ponds 1 and 2 to determine success of treatment and translocation efforts.
3. Reintroduce Largemouth Bass to Anderson Ponds 1 and 2.
4. Complete creel survey after fish population and fisheries have become re-established.

LAKE WALCOTT

ABSTRACT

Smallmouth Bass monitoring at Lake Walcott was completed with boat electrofishing in 2012. A total of 524 Smallmouth Bass were collected. CPUE was 150 ± 10 (80% C.I.) Smallmouth Bass/h. Total length of sampled fish ranged from 65 to 465 mm. Bass weights ranged from 2 to 1,807 g and the mean relative weight (W_r) was 136 (n = 256, SD = 16). PSD and RSD (S-Q) of Smallmouth Bass were 53 and 47, respectively. A subsample of Smallmouth Bass (n = 234) was aged and included 12 age classes. Maximum age and length were 12 years and 460 mm, respectively. Annual mortality (ages 1 - 12) was estimated at 25%.

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INTRODUCTION

Lake Walcott was formed in 1906, following completion of Minidoka Dam with primary purposes of irrigation and hydroelectric power production. The reservoir encompasses a surface area at full pool of approximately 4,900 hectares. Surface elevation at full pool is 1,385 m. The Minidoka National Wildlife Refuge surrounds Lake Walcott, which is located about 19 km northeast of the town of Rupert, Idaho in Blaine, Cassia, and Minidoka counties. The reservoir is relatively shallow and composed of large marsh-like areas along the reservoir's perimeter. Game fish species present in Lake Walcott include: Smallmouth Bass *Micropterus dolomieu*, Rainbow Trout *Oncorhynchus mykiss*, and Yellow Perch *Perca flavescens*, and hatchery-stocked Snake River White Sturgeon *Acipenser transmontanus*.

Lake Walcott is divided into boating and non-boating access areas by the Minidoka National Wildlife Refuge. The sections include a main reservoir area and an upper more riverine reservoir area. Sampling efforts were randomly divided among both reservoir sections to evaluate angling and habitat impacts on relative fish abundance and, specifically, the Smallmouth Bass population.

Lake Walcott bass sampling are conducted periodically to maintain and evaluate trends in the Smallmouth Bass population. The objective of these efforts are to describe the Smallmouth Bass abundance and size structure of the population; and to maintain long-term monitoring datasets.

METHODS

We characterized the Smallmouth Bass population in Lake Walcott by calculating common fisheries population indices including relative abundance (CPUE), stock structure, fish condition (W_r), fish growth (length-at-age), and fish survival (catch curve). Smallmouth Bass sampling was conducted June 13, 2012 when bass typically are concentrated in shallow habitat for spawning. We utilized boat electrofishing at ten shoreline transects until 15 minutes was expended at each transect. Sampling occurred at night using a pulsed-DC (60 Hz) waveform and a 24% duty cycle (See Appendix B for gear description). Relative abundance was measured as average catch per unit effort (CPUE) and reported as fish/h. Captured Smallmouth Bass were measured for total length (TL) to the nearest mm, and weighed to the nearest gram. We calculated proportional stock density (PSD, Anderson and Newman 1996) using FAST to describe size structure. Stock structure was further described as incremental RSD (S-Q). Relative weights (W_r) were calculated in EXCEL© software and are reported as the mean W_r of the entire sample.

Otoliths were collected from up to five bass for each 1-cm length bin sampled. Otoliths were prepared by centrally cracking and burning the broken edge with an alcohol burner. Otoliths were immersed in mineral oil and viewed at 30-40x magnification using a dissecting microscope. Mean length-at-age was calculated for each length bin. Fish growth was estimated using the mean length-at-age summary in Fisheries Analysis and Simulation Tools, Version 2.1© (FAST). Annual mortality and survival were estimated using a catch curve generated in FAST.

RESULTS

A total of 484 Smallmouth Bass were collected. Average CPUE (80% CI) was 150 ± 10 SMB/h. Total length of sampled fish ranged from 65 to 465 mm with a mean length of 176 ± 6 mm (Figure 10). Stock density was 53, 23, 22, and 8 for PSD, RSD-P, RSD-M, and RSD-T, respectively. Mean W_r for each size class of bass was 125, 132, 148, 150, and 151% for sub-stock, stock, quality, preferred, and memorable sized bass, respectively (Figure 11). No trophy sized bass were encountered.

A subsample of Smallmouth Bass (*n* = 234) was aged with 12 age classes identified. Maximum age in the sample was 12 years, with a length of 460 mm (Figure 12). Legal harvest length for Smallmouth Bass at Lake Walcott is 305 mm. Growth data from 2012 suggest bass do not reach harvestable length until age 5 in Lake Walcott.

DISCUSSION

It appears the Smallmouth Bass population at Lake Walcott have remained stable in terms of relative abundance since 2009 based on CPUE. Average length at age 5 in the 2012 sampling decreased from 2009 (Table 7), which may suggest density dependent growth. Size structure also differed from 2009 to 2012. In 2012, bass PSD was 53, compared to 45 in 2009. Furthermore, RSD(S-Q) was 55 in 2009 compared to 47 in the 2012. These size distribution shifts represent an increase in the proportion of sub-stock (≤ 300 mm) bass in Lake Walcott. Length-at-age estimates from 2012 suggest Smallmouth Bass are still reaching harvestable lengths (305 mm) in Lake Walcott by age 5. However, mean length at age 5 decreased from 387 to 331 mm in 2009 and 2012, respectively. Furthermore, a 2005 survey supports a continued decreasing trend in growth and a steady increase in population density (Ryan and Megargle 2005). Smallmouth Bass in Lake Walcott continue to maintain above average W_r, for all present size classes.

The growing number of bass tournaments at Lake Walcott suggests it continues to be a popular destination for Smallmouth Bass anglers. Strong recruitment is evident in the sample with good numbers of age-1 and 2 fish present. Smallmouth Bass appear to be healthy across all age classes based on relative weights being greater than 100. However, the growing bass population appears to be showing the beginning signs of density-dependent growth and the potential for stunted bass. Further monitoring is needed to track trends of increasing relatively and abundance and reduced growth documented since 2005. Additionally, bass exploitation should be determined. If trends continue towards increased bass numbers and slower growth, increasing harvest may be needed to sustain quality bass in Lake Walcott.

RECOMMENDATIONS

1. Continue bass monitoring of population structure.

2. Complete exploitation study or creel survey to determine bass harvest at Lake Walcott.

MAGIC RESERVOIR

ABSTRACT

Smallmouth Bass *Micropterus dolomieu* have become established recently in Magic Reservoir, likely the result of an illegal fish introduction. The consequences of this introduction for existing recreational fisheries for stocked trout and Yellow Perch *Perca flavescens* are not well understood, but will depend on whether Smallmouth Bass (bass) becomes widespread and abundant. In order to improve understanding, we completed survey efforts during 2012 to determine relative abundance and size structure. A total of 105 bass were sampled with boat electrofishing. Catch-per-unit-effort was 42 fish/h (± 23; 80% CI). Average length and weight were 212 (± 10) mm, and 194 (± 29) grams, respectively. Total length of sampled fish ranged from 60 to 430 mm. Weight ranged from 3 to 1,468 g. Mean relative weight was 101 (n = 87, SD = 14). Smallmouth Bass PSD was 21 with an incremental RSD (S-Q) of 79. A sub-sample of bass was aged and eight age classes were represented with a maximum age of 11. Annual mortality was estimated at 30%.

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INTRODUCTION

Magic Reservoir was created in 1909 by damming the Big Wood River near Stanton Crossing, Idaho. The earthen dam was raised to a maximum height of 34.4 m during 1917, increasing the full pool surface area to 1,529 ha. The reservoir fluctuates substantially annually based on inflows and irrigation demand. Magic Reservoir supports several gamefish species including Brown Trout *Salmo trutta*, Rainbow Trout *Oncorhynchus mykiss*, Smallmouth Bass *Micropterus dolomieu*, and Yellow Perch *Perca flavescens* with year-round fishing seasons. Trout populations are supported both by natural recruitment from the Big Wood River and from hatchery stocking. Most angling effort is directed towards trout and Yellow Perch, especially during winter ice-fishing seasons. Smallmouth bass have been illegally introduced recently and may have the potential to effect other fish populations and associated fisheries. Because of this, staff are interested in monitoring their population and its characteristics to determine if management direction needs to be altered. For 2012 sampling efforts, the objectives were to evaluate the size and age structure, growth, and relative abundance of Smallmouth Bass in Magic Reservoir.

METHODS

We characterized the Smallmouth Bass population in Magic Reservoir by calculating common fisheries population indices including relative abundance (CPUE), stock structure, fish condition (W_r), fish growth (length-at-age), and fish survival (catch curve). Smallmouth Bass sampling was conducted June 18 and 19, 2012 when bass typically are concentrated in shallow habitat for spawning. We utilized boat electrofishing at 10 shoreline transects until 15 minutes was expended at each transect. Sampling occurred at night using a pulsed-DC (60 Hz) waveform and a 24% duty cycle (See Appendix B for gear description). Relative abundance was measured as average catch per unit effort (CPUE) and reported as fish/h. Captured Smallmouth Bass were measured for total length (TL) to the nearest millimeter, and weighed to the nearest gram. We calculated proportional stock density (PSD) using FAST to describe size structure. Stock structure was further described as incremental RSD (S-Q). Relative weights (W_r) were calculated in EXCEL© software and are reported as the mean *Wr* of the entire sample.

Otoliths were collected from up to five bass for each 1-cm length bin sampled. Otoliths were prepared by centrally cracking and burning the broken edge with an alcohol burner; otoliths were immersed in mineral oil and viewed at 30-40x magnification using a dissecting microscope. Mean length-at-age was calculated for each length bin. Fish growth was estimated using the mean length-at-age summary in Fisheries Analysis and Simulation Tools, Version 2.1© (FAST). Annual mortality and survival were estimated using a catch curve generated in FAST.

RESULTS

A total of 105 Smallmouth Bass were sampled. Catch per unit effort (CPUE, ± 80% CI) was 42 ± 23 bass/h. Lengths ranged from 60 to 430 mm (Figure 13). Average length and weight of bass were 212 (±10) mm and 194 (± 29) g, respectively. Smallmouth Bass PSD was 21 with a RSD (S-Q) of 79. Ages were estimated for 89 bass. Eight age classes were present, with a maximum age of 11 years (Figure 14). Annual mortality was estimated at 30%. Mean relative weight (W_r) was 101 (SD = 14; Figure 15).

DISCUSSION

The bass population at Magic Reservoir is increasing based on higher CPUE. During 2010, CPUE equaled 2 bass/h, whereas during 2012 CPUE increased to 42 bass/h, an increase of 20 fold. There are two possible explanations for the significant change in CPUE. The first is that the population is rapidly expanding within the reservoir. The second explanation is that some sampling differences may have occurred between surveys (e.g. water temperature differences or habitat/site selection differences). PSD values also increased from 2010 to 2012, but are still relatively low compared to other populations due to a preponderance of sub-stock fish (≤ 300 mm). Age-at-length data suggest fish ≤ 300 mm are age 5 or younger. No fish age 5 or older were encountered in 2010. Limited historical trend information is available for this evaluation due to this being a newly-established population and this being the second bass sampling effort at Magic Reservoir. Additional surveys should be conducted periodically to monitor population trends and determine appropriate management direction.

RECOMMENDATIONS

1. Monitor this bass population at three to five year intervals to assess population trends and determine appropriate management direction.

2. Periodically assess the entire fish community using standard lowland lake sampling protocols.

3. During the next evaluation, tag bass and estimate exploitation using the Tag-You're-It program.

BIG WOOD RIVER

ABSTRACT

Trout populations in the Big Wood River are sampled at three-year intervals to monitor trends and to determine whether adjustments to management strategies are necessary. Monitoring is completed with raft electrofishing at three transects (Hailey, Gimlet, and Boulder). In 2012, abundance estimates for all trout species ≥ 200 mm at the Hailey and Gimlet sites were 1,029 ± 255 and 1,003 ± 194 (95% CI), respectively. Abundance was not estimated for the Boulder Transect due to equipment failure.

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INTRODUCTION

The Big Wood River originates in the Smokey, Boulder, and Pioneer Mountain ranges of south central Idaho. The river flows south, southwest from its origin to its confluence with the Little Wood River west of Gooding, Idaho, where combined they form the Malad River. The Big Wood River possesses one large mainstem impoundment, Magic Reservoir. Downstream from the dam, the river is used extensively for irrigation and is often dewatered seasonally with the entire discharge being diverted into the Richfield Canal.

The Big Wood River provides a popular fishery with angling opportunities for Rainbow Trout *Oncorhynchus mykiss*, Brown Trout *Salmo trutta*, Brook Trout *Salvelinus fontinalis*, and Mountain Whitefish *Prosopium williamsoni*. The Big Wood River has been managed through a mosaic of regulations and boundaries originally implemented in 1977 (Thurow 1987). These regulations are complex, causing confusion among some anglers. Regulations were put in effect in an effort to both enhance trout size structure, and due to local support for fly fishing and catch-and-release trout angling opportunity. Currently, the Upper Big Wood River (upstream of Magic Reservoir) has five different boundaries separating four differing regulation strategies. Within each regulation boundary, there are three differing date ranges that dictate fishing, harvest, or gear type closures. The uppermost and lowermost regulation boundaries on the Big Wood River are managed using the Magic Valley Regions general fishing regulations; which allow 25 Brook Trout, 6 Rainbow or Brown Trout, and 25 Mountain Whitefish a day. Trend monitoring reaches represent the three uppermost regulation sections on the Big Wood River, and include: a restrictive slot limit on trout with no harvest between 305 mm and 406 mm (Hailey), catch-and-release only (Gimlet), and general regulations (Boulder). Additionally, hatchery supplementation occurs in both the uppermost (above North Fork) and lowermost (Below Glendale Bridge) sections of the Big Wood River upstream of Magic Reservoir; and coincides with the general regulation boundaries.

The Big Wood River is monitored triennially at three transects that represent the three uppermost regulation strategies/boundaries. Because of the fisheries popularity, local angling constituents, and contentious regulatory history, long-term monitoring on the Big Wood River is important in evaluating population trends to ensure regulations are meeting both management goals and local public expectations. Our objective is to continue these monitoring efforts to evaluate potential changes in population dynamics of all trout species present and Mountain Whitefish.

METHODS

Fish were collected with a 9’ Outcast inflatable canoe electrofishing unit fitted with two mobile anodes connected to 15-m cables. The cathodes consisted of three octopus cable bar that totaled 1.5 m in length and consisted of 15 cable danglers. The inflatable canoe carried a 5000-W generator (Honda EG500X), a Midwest Lake Electrofishing Systems (MLES) Infinity electrofisher, and a live well for holding fish. Oxygen was pumped to the live well (2 L/min) through a 10” fine bubbler air-stone. Pulsed direct current (DC) was produced by the generator. Settings were 24% duty cycle, 60 pulses per second, 300-400 volts, producing 1,000-2,000 W.

Rainbow Trout, Brown Trout, Brook Trout, and Mountain Whitefish were sampled at three transects during October of 2012. Marking runs were conducted on October 1st, 2nd, and 3rd at the Boulder, Gimlet, and Hailey transects, respectively. Recapture runs occurred on October 7th, 8th, and 9th at the Boulder, Gimlet, and Hailey transects, respectively. Flow was approximately 4 m^3/s. Crews consisted of eight or ten people. Two people operated the mobile anodes, one person guided the canoe and operated the control box which includes the safety switch and output settings. The remaining people were equipped with dip nets and captured stunned fish. Only trout and whitefish were placed in the live well. When the live well was judged to be at capacity, the crew stopped at the nearest riffle to process fish.

Fish were marked with a 7-mm diameter hole from a standard paper punch with an upper caudal fin. Only fish longer than 100 mm were marked. Fish were measured for total length (mm) and with a subset of trout being weighed (g). Fish were released 50 to 100 m upstream from the processing site to reduce the potential of movement out of the site or into areas yet to be electrofished. During the recapture effort, all trout greater than 100 mm were captured and placed in the live well. Fish were examined for marks on the caudal fin. All fish were measured for total length (mm).

We estimated the fish population using mark-recapture techniques with one marking run and one recapture run separated by seven days. Fish were marked in the upper caudal fin using a hole punch. Individual fish data collected included total length in mm, weight to the nearest gram, species, and any markings (punch, ad clip, etc.). All fish collected were released back to their respective stream reach. Due to low post-mark survival and detection probability, fish smaller than 100 mm were not marked, but were included in the total catch per unit effort index (CPUE).

Estimates of Rainbow Trout and Mountain Whitefish were made using a modified Peterson mark-recapture estimator (Ricker 1975). Estimates were summarized in 100 mm length bin increments for fish equal or greater than 200 mm. A minimum of five recaptures for each length bin was required for estimation. Length groups that did not receive a minimum of five fish collected were then pooled with the next greatest length bin.

Average wetted stream widths for each transect were collected the week following the recapture efforts to estimate density for each target species. Transect widths were measured with a Leica LRF 900 Rangemaster rangefinder at 10 randomly selected locations within each electro-fishing transect. Transect waypoints were marked for future replication using a Magellan Sporttrack Topo GPS (Appendix A).

Length-at-age and mean total length were used to characterize stock structure in each reach. Sectioned otolith samples were examined to determine fish age. In transects where a population estimate could not be estimated (i.e Boulder transect), relative stock densities (RSD – 400) were determined for Rainbow Trout. RSD-400 is calculated as the number of fish ≥ 400 mm divided by the number of fish ≥ 200 mm. Relative weight was calculated for Rainbow Trout and reported as mean relative weight by 100-mm length groups in Fisheries Analysist+ (FA+); software developed by Montana Fish Wildlife & Parks (MFWP 2004).

Population estimates (N) were calculated for each site separately as # fish/km for comparison among transects and previous years. Observed mortalities during the marking run were recorded and excluded from the population estimates. Catch composition was determined using the combined total catch from the mark and recapture runs. The number of marked fish by site and recapture efficiency were also calculated. Recapture efficiency (R_{eff}) was calculated as

$$R_{eff} = R/C$$

where R is the number of recaptures collected and C is the total number of fish collected during the recapture run.

RESULTS

Lower Hailey Transect

A total of 2,156 target specimens were collected in the Lower Hailey transect during the mark and recapture runs. During the marking run 1,126 Rainbow Trout, 27 Mountain Whitefish, 32 Brown Trout, and 42 Brook Trout were marked. Recapture efficiency (*Reff*) for Rainbow, Brook, and Brown Trout was 11, 27, and 15%, respectively, while efficiency for Mountain Whitefish was 13%.

The combined trout species density for the entire regulation transect (Glendale Bridge to Gimlet Rd. Bridge) was 1,020 trout/km (Table 7). Catch composition was 92% for Rainbow Trout, 3% for Brown Trout, 3% Brook Trout, and 2% Mountain Whitefish. The mean total length for Rainbow, Brook, and Brown Trout in the Hailey transect was 131 ± 2 mm, 152 ± 13 mm, and 227 ± 11 mm, respectively. The mean total length for Mountain Whitefish was 291 ± 24 mm.

Rainbow Trout (≥ 200 mm) abundance estimate for the Hailey transect were 1,029 ± 255 (95% CI). Mountain Whitefish (≥ 100 mm) abundance in the Hailey transect was estimated at 202 ± 111 (95% CI).

Gimlet Transect

A total of 712 target specimens were collected in the Gimlet transect during the mark and recapture runs. During the marking run 233 Rainbow Trout and 11 Mountain Whitefish were marked. Due to limited encounter rates Brown Trout (n = 2) and Brook Trout (n = 1) were not marked. Recapture efficiency (*Reff*) for Rainbow Trout and Mountain Whitefish was 12% and 2%, respectively.

The combined trout density for the Gimlet regulation transect (Gimlet Bridge to the railroad trestle) was 1,004 trout/km (Table 8). Catch composition was 91% Rainbow Trout and 9 % Mountain Whitefish. The mean total length for Rainbow Trout and Mountain Whitefish in the Gimlet transect was 197 ± 4 mm and 116 ± 15 mm, respectively.

Rainbow Trout (≥ 200 mm) abundance estimate for the Gimlet transect was 1,003 ± 194 (95% CI). Mountain Whitefish (≥ 100 mm) abundance could not be estimated due to insufficient recaptures.

Kendall Gulch (Boulder) Transect

Due to equipment failure, only a marking run was completed for the Boulder transect; therefore, no population estimate was calculated. A total of 53 target specimens were collected. Catch composition was 70% Rainbow Trout, 17% Mountain Whitefish, and 13% Brook Trout. The mean length for Rainbow Trout, Mountain Whitefish, and Brook Trout in the Boulder transect was 192 ± 24 mm, 390 ± 6 mm, and 339 ± 21 mm respectively. Catch per unit effort (CPUE) of Rainbow Trout was 24 trout/km, and for Mountain Whitefish was 6 fish/km.

Ageing and Stock Structure

Otoliths were collected from a subsample of Rainbow Trout (n = 110) for all sample transects. Six age classes were present in the sample with a maximum age of six years represented. Mean length-at-age 4 and 6 were 314 mm and 384 mm, respectively (Figure 16).

Mean relative weights for each 100 mm length bin (200-400 mm) of Rainbow Trout was 106 (≤ 200 mm), 98 (201-300 mm), and 74 (≥ 301 mm; Figure 17). Combined PSD was 15 ± 2 (95% C.I.) with an RSD-Q of 94. Stock density for 100 mm (200-400 mm) length bins of Rainbow Trout sampled was 15, 94, and 16%, respectively.

DISCUSSION

Overall combined trout densities for the last three surveys have been stable. Similarly, the combined Big Wood River Rainbow Trout densities from Gimlet and Hailey reaches did not differ substantially from 2009 (108 RBT/100 m) to 2012 (106 RBT/100 m). However, both have decreased since 2006 (250 RBT/100 m). Presumably, the lower densities compared to 2006 may explain the subtle increase in length-at-age observed between 2009 and 2012. High water events in both 2010 and 2011 may have impacted spawning and recruitment in the population of the Gimlet reach as habitat noticeably was altered in stream as compared to the 2009 sampling event.

Condition of Rainbow Trout measured as relative weight, was good among all transects. Mean relative weights were 106 (200-300 mm) and 98 (≥ 300 mm) in 2012, compared to 82 and 89, respectively in 2009. Overall PSD declined in 2012 compared to 2009, perhaps due to high recruitment following advantageous water years

Mountain Whitefish CPUE remained consistent with previous years with a slight increase in 2012. Trends in Rainbow Trout density and population structure suggest that the Hailey reach is maintaining a stable trend with relatively good fish condition. However, within the Gimlet reach relative weights appeared to decline considerably within larger cohorts. Several large Rainbow Trout sampled within the Gimlet transect appeared emaciated. This may be a result of the Gimlet reaches catch-and-release only regulations, which potentially increase densities and competition among mature Rainbow Trout. Because our sampling event took place in fall, reduced relative weights are not likely a result from poor post spring spawning conditions.

RECOMMENDATIONS

1. Maintain standard stream survey every three years to document long-term trends in the Big Wood River.

2. Compare relative weights across regulation reaches to evaluate impacts of differing regulations.

3. Monitor Brown Trout population expansion and impacts to Mountain Whitefish and Rainbow Trout.

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FIGURES

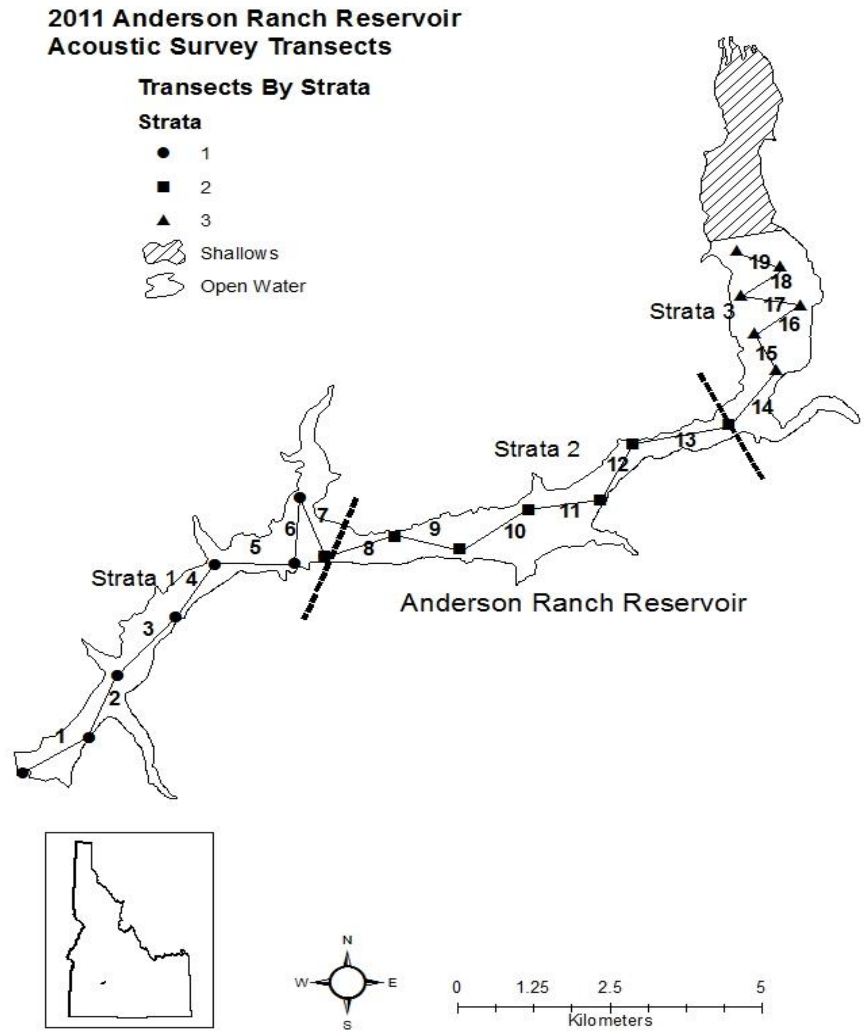


Figure 1. Stratified hydroacoustic survey transects utilized to estimate kokanee abundance at Anderson Ranch Reservoir, Idaho.

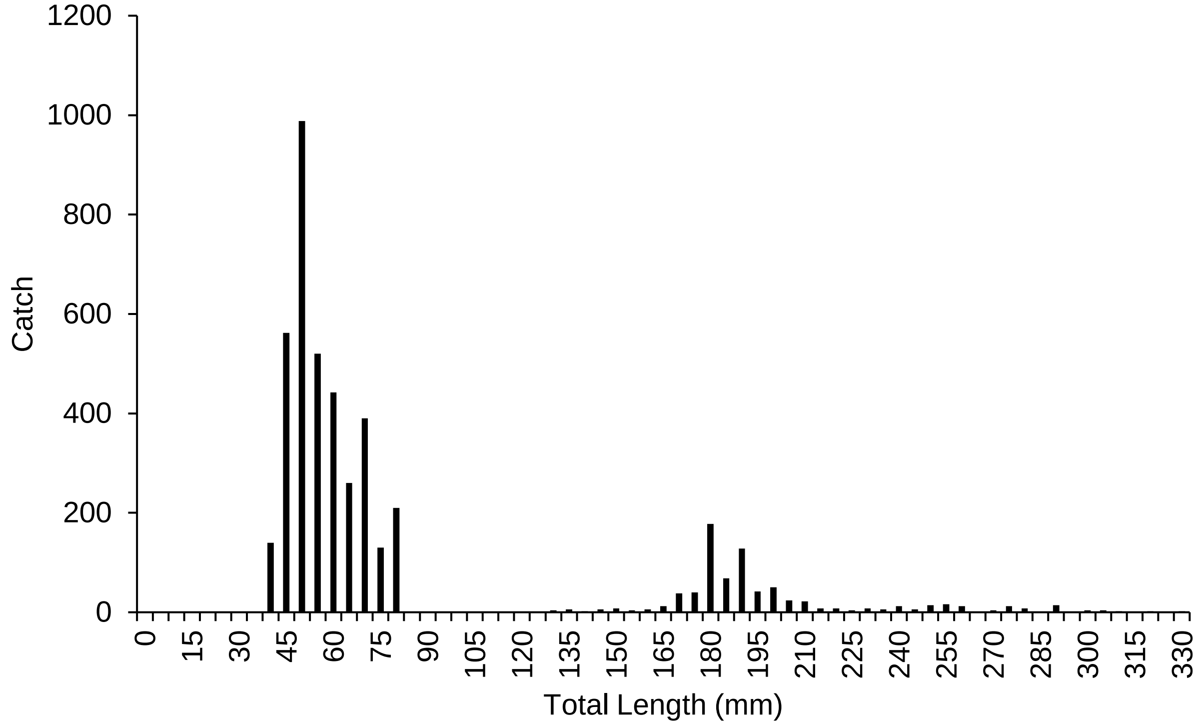


Figure 2. Length-frequency histogram for kokanee sampled with a trawl from Anderson Ranch Reservoir in 2012.

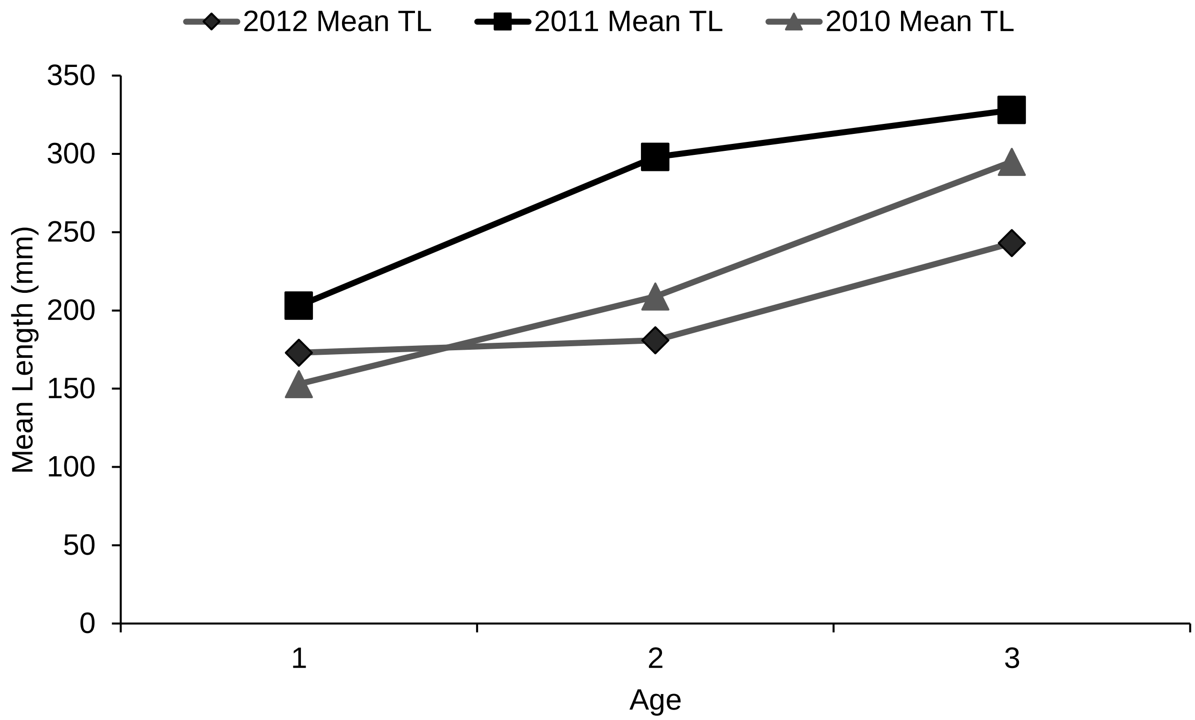


Figure 3. Comparative mean length-at-age for trawl-caught kokanee from Anderson Ranch Reservoir. Sample sizes for 2010, 2011, and 2012 were 125, 80, and 152, respectively.

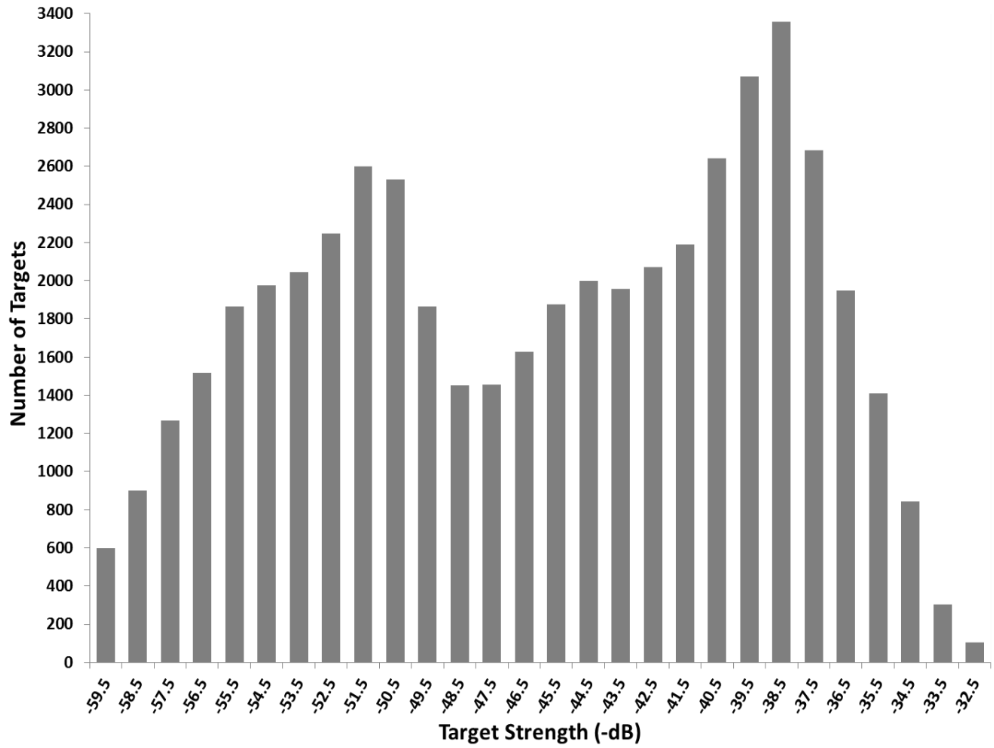


Figure 4. Frequency distribution of all fish target strengths recorded in hydroacoustic transects from the pelagic area of Anderson Ranch Reservoir, August 1-2, 2012.

Figure 5. Hagerman Wildlife Management Area. Arrows denote flow and control structures

Figure 6. Post draw-down pools in Anderson Pond 1 (top) and Anderson Pond 2 (bottom). Areas circled in red indicate isolated pools of water intended to be treated with piscicide.

Figure 7. Location of steel barriers (red) put in between Anderson ponds 1 and 2 on the Hagerman WMA in fall 2012.

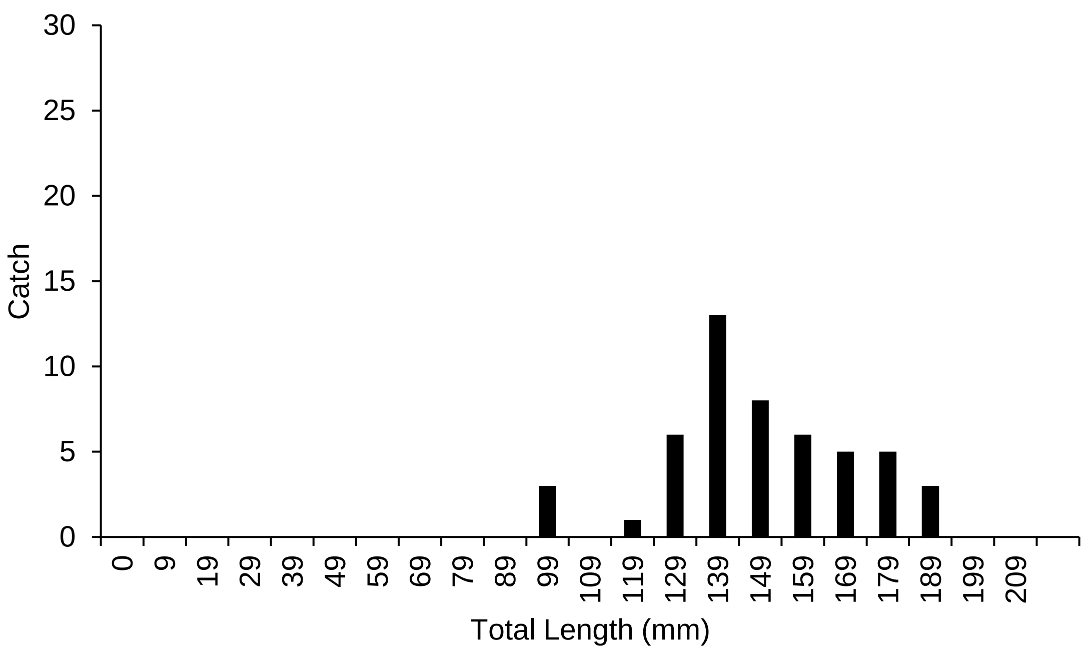


Figure 8. Length-frequency histogram of Bluegill (*n* = 50) translocated into Anderson Pond 1.

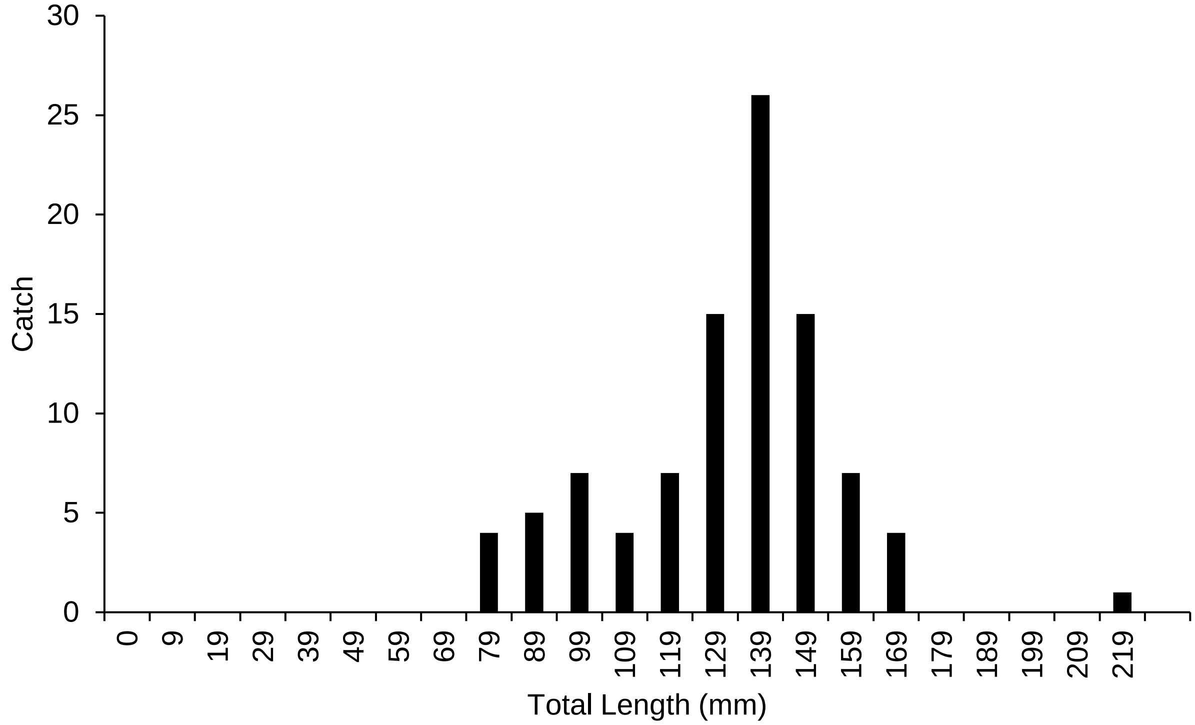
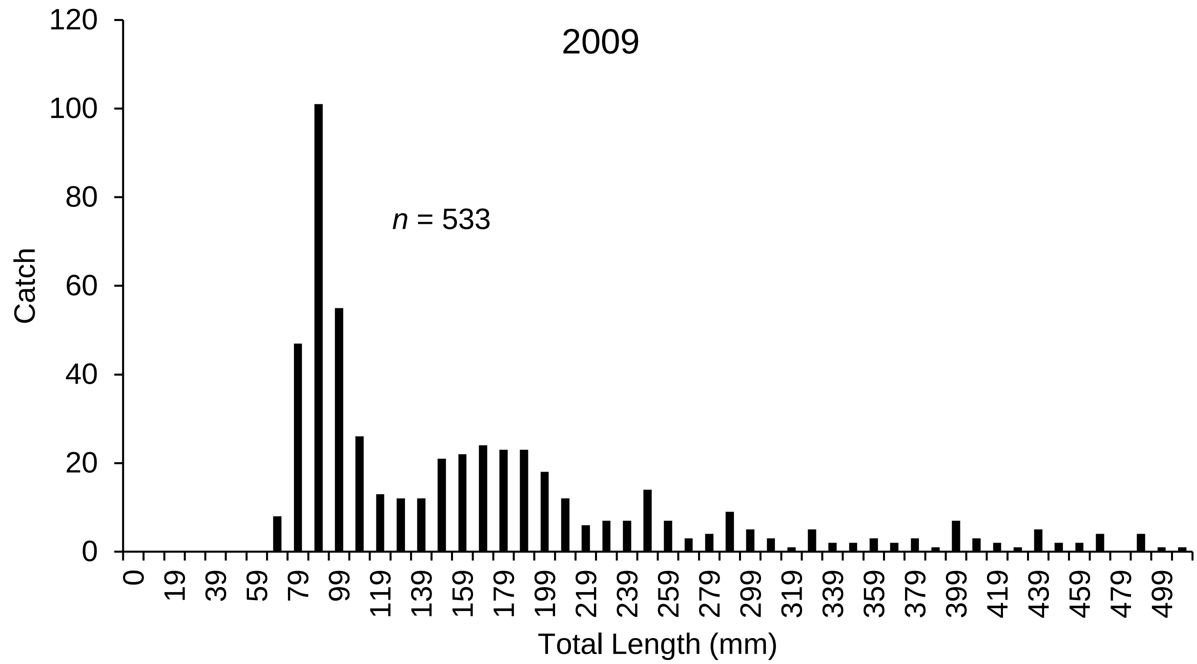


Figure 9. Length-frequency histogram of Bluegill (*n* = 100) translocated into Anderson Pond 2.



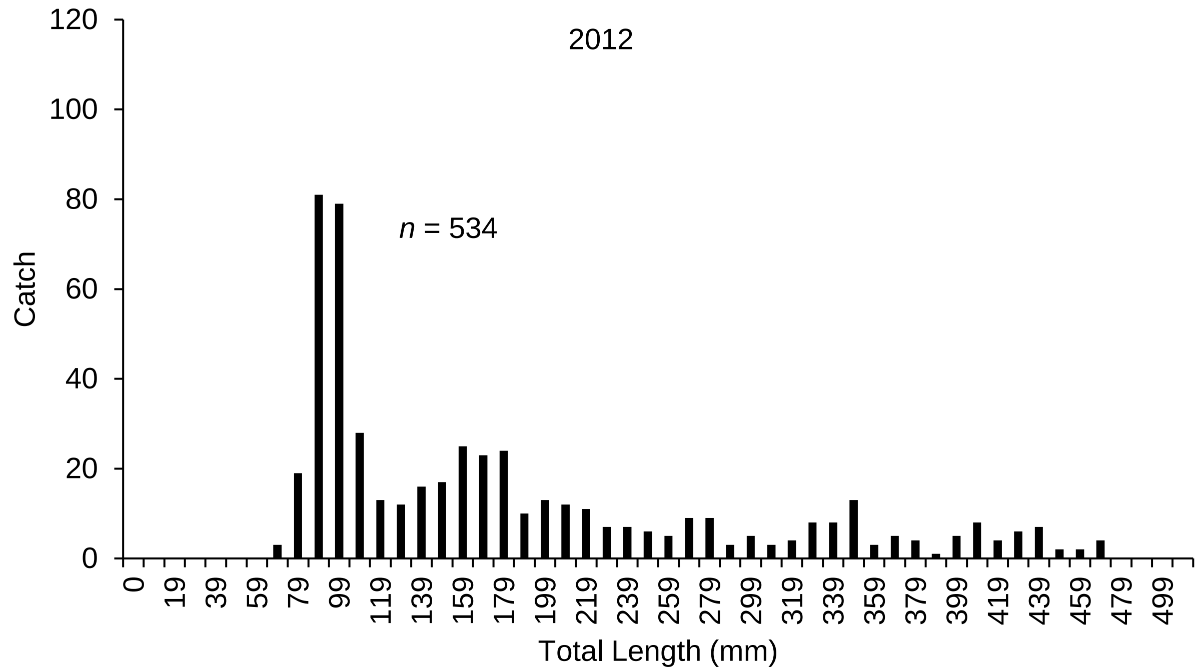


Figure 10. Length-frequency histogram for Smallmouth Bass sampled in Lake Walcott during 2009 and 2012.

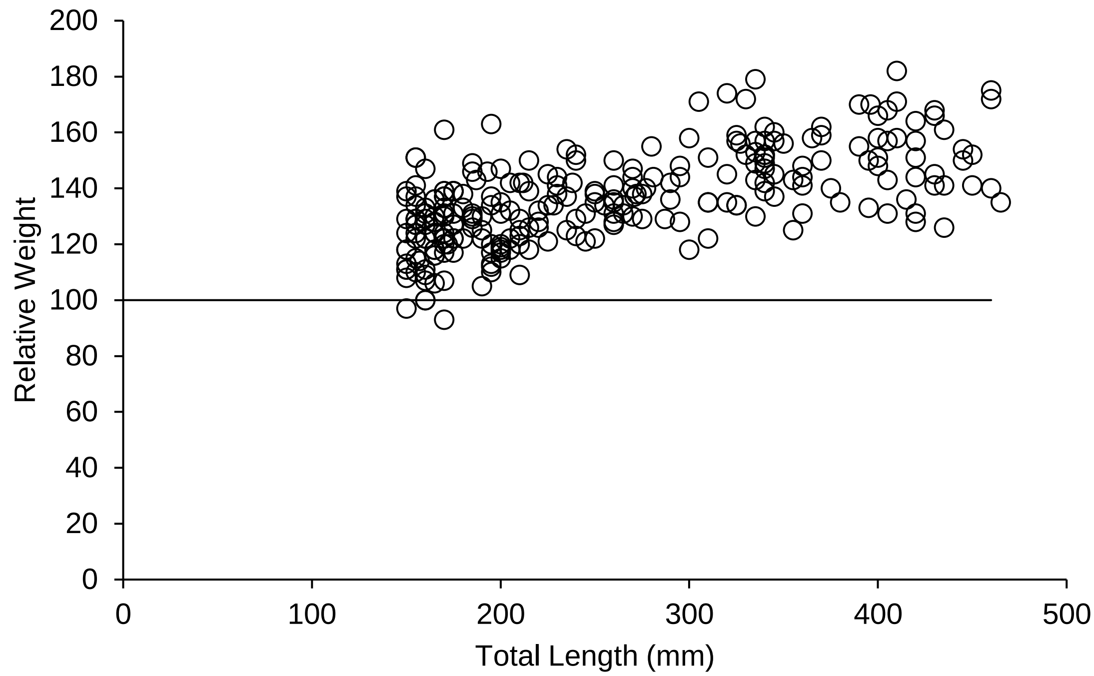


Figure 11. Relative weight for a sub sample of Smallmouth Bass (n = 234) sampled from Lake Walcott in 2012.

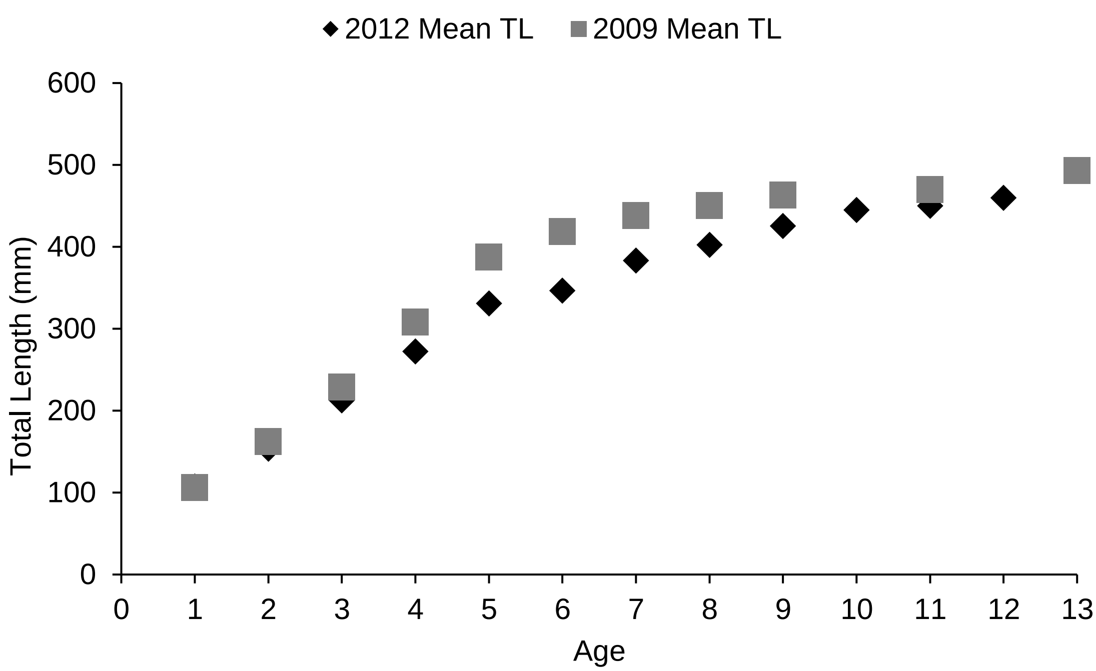


Figure 12. Length-at-age of Smallmouth Bass sampled from Lake Walcott during 2009 (n = 216) and 2012 (n = 234).

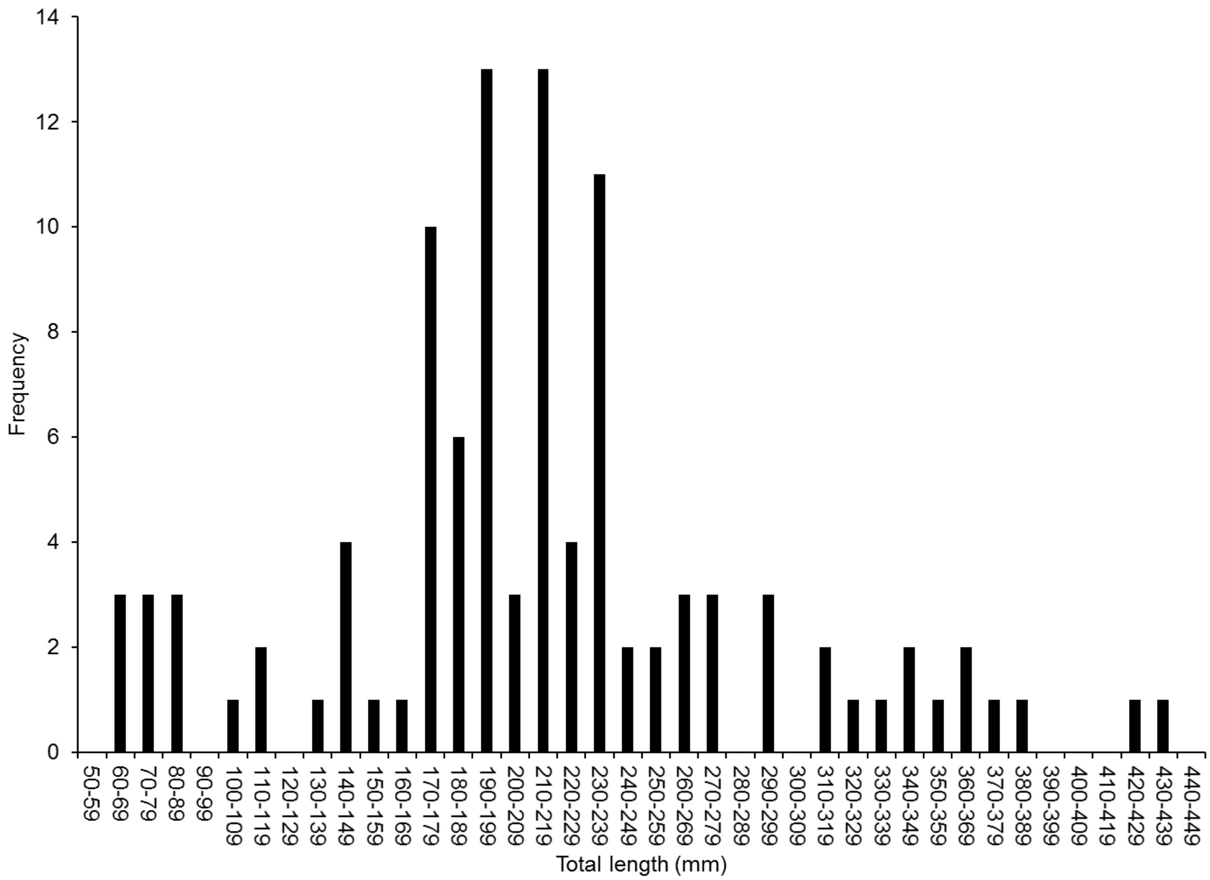


Figure 13. Length-frequency histogram for Smallmouth Bass sampled from Magic Reservoir during June 2012.

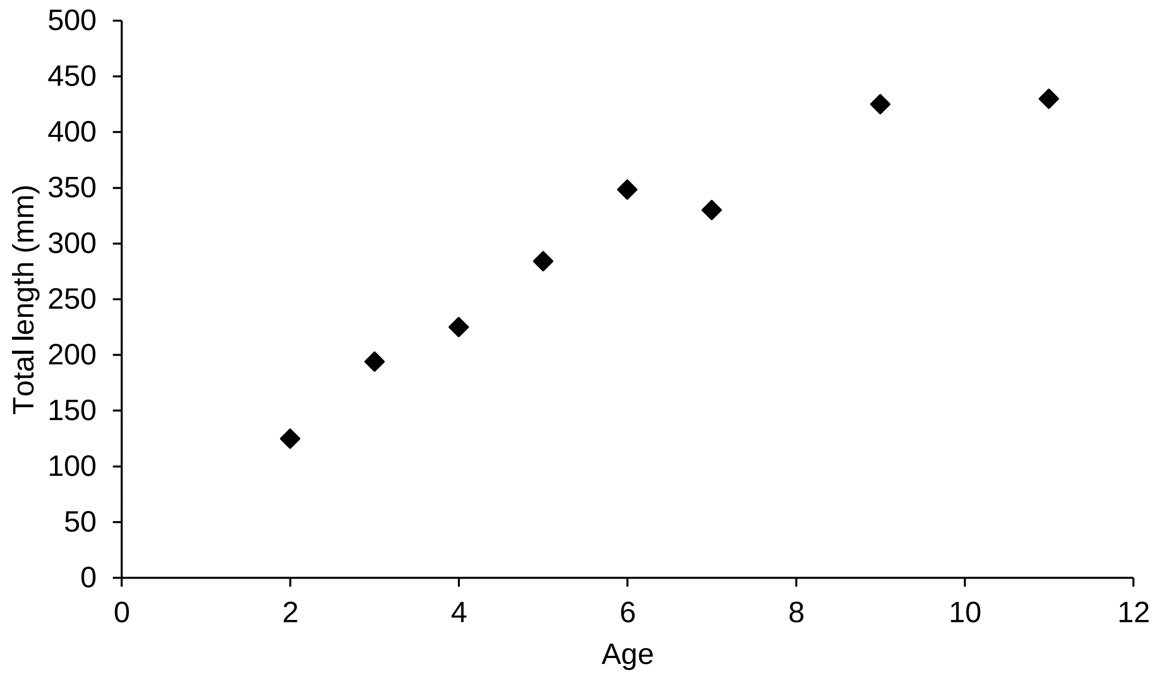


Figure 14. Length-at-age of Smallmouth Bass (n = 89) sampled from Magic Reservoir during June 2012.

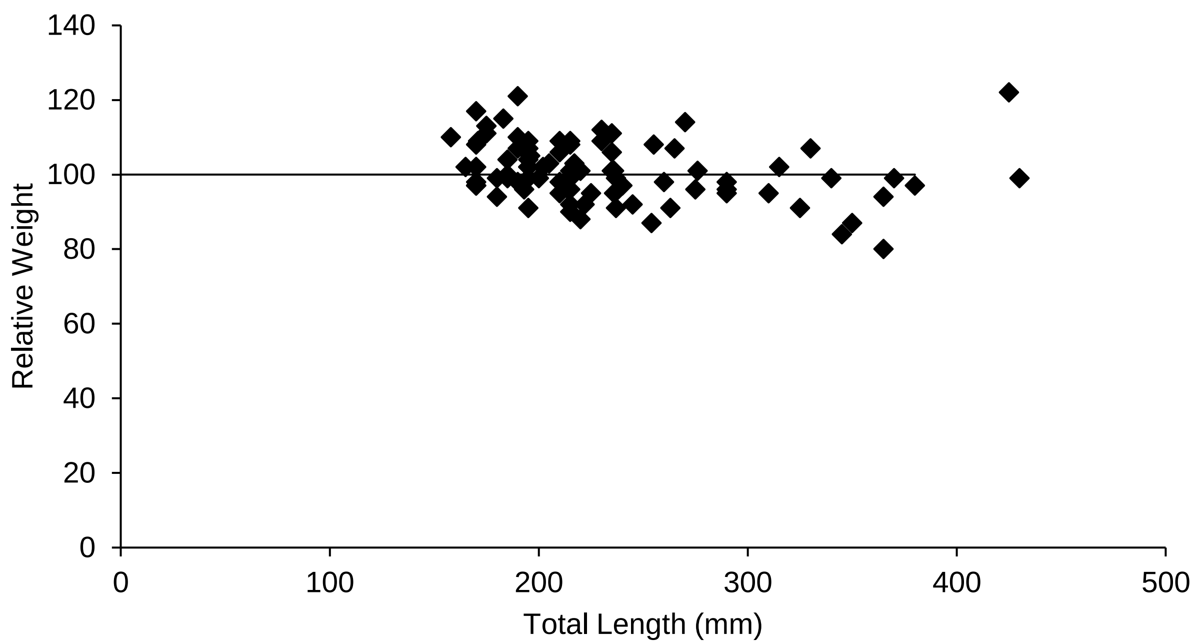


Figure 15. Relative weight of a sub sample of Smallmouth Bass (n = 89) sampled from Magic Reservoir during June 2012.

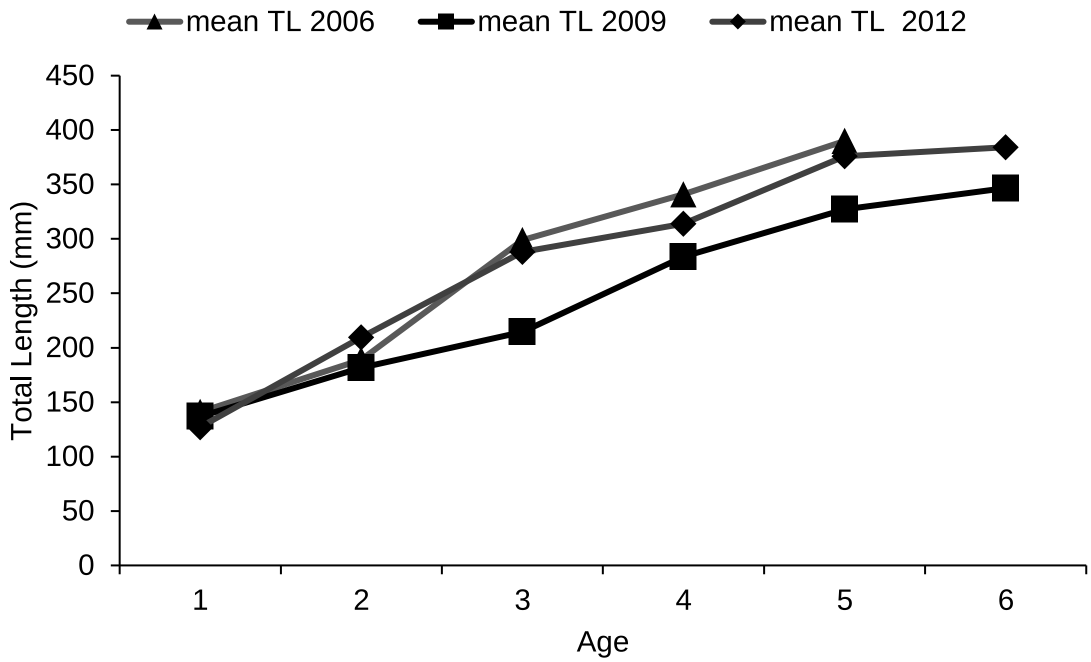


Figure 16. Comparative length-at-age plot for Rainbow Trout sampled from the Big Wood River in 2006 (*n* = 48), 2009 (*n* = 112), 2012 (*n* = 110).

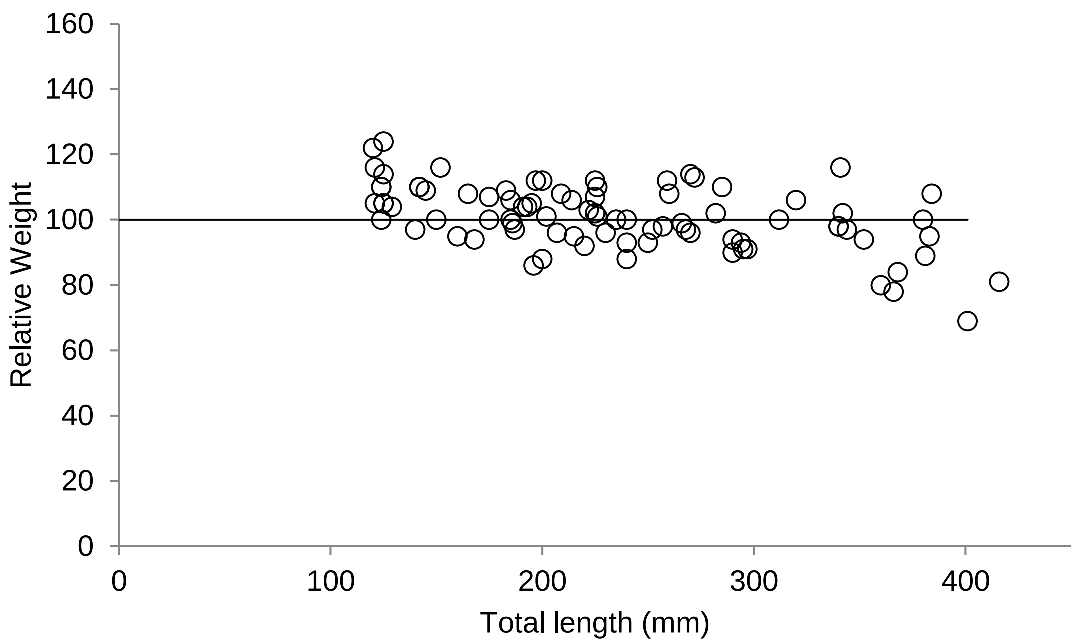


Figure 17. Relative weight of Rainbow Trout (*n* = 88) sampled from the Big Wood River in 2012.

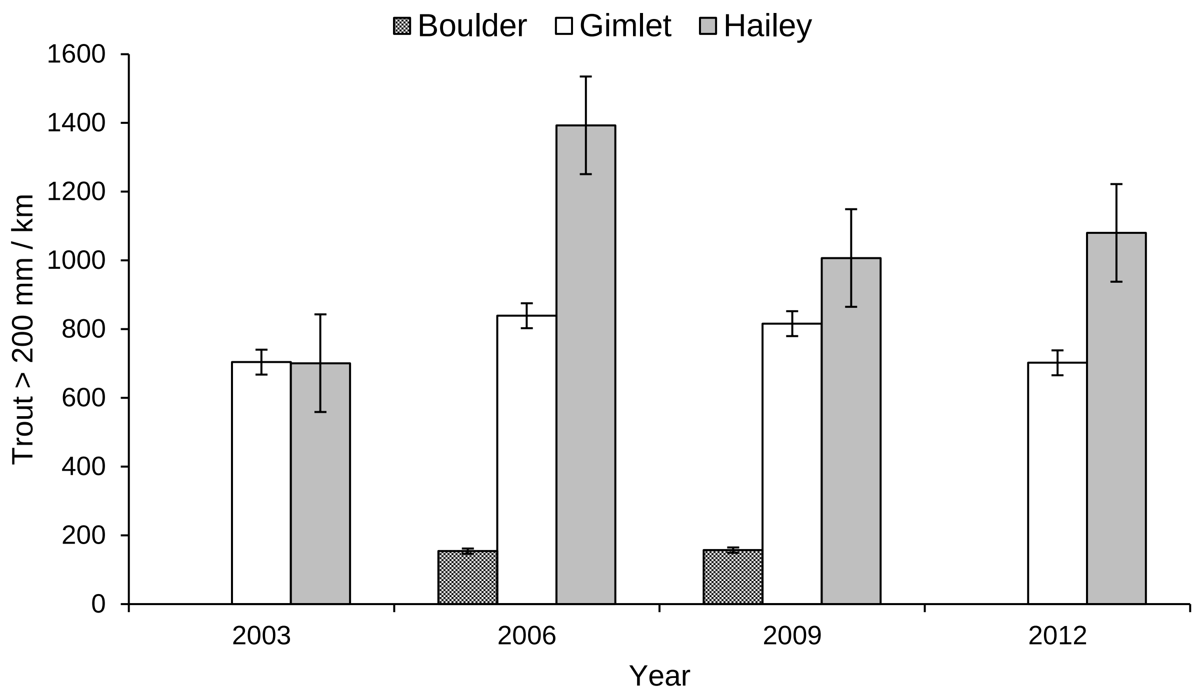


Figure 18. Comparative linear densities of all trout (≥ 200 mm) per kilometer in three transects sampled in the Big Wood River between 2003 and 2012.

TABLES

Table 1. Population estimates for kokanee from 2012 trawling in Anderson ranch Reservoir.

Strata	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Total
			Abundance (#)				
1	3,420,589	805,596	68,255	0	0	0	4,294,440
2	2,789,253	253,678	9,218	1,493	0	0	3,053,642
3	147,195	140,150	33,601	2,710	0	0	323,656
Total	6,357,038	1,199,423	111,074	4,203	0	0	7,671,738
			Density (#/ha)				
1	2,215	522	44	0	0	0	2,781
2	1,807	164	6	1	0	0	1,978
3	95	91	22	2	0	0	210
Total	4,117	777	72	3	0	0	4,969
			Biomass Estimate (kg)				
1	7,595	51,241	4,560	0	0	0	63,396
2	6,286	17,013	714	446	0	0	24,459
3	386	10,641	4,719	845	0	0	16,590
Total	14,266	78,895	9,993	1,291	0	0	104,445
			Standing Crop Estimates (kg/ha)				
1	13	84	8	0	0	0	104
2	11	29	1	1	0	0	42
3	1	30	13	2	0	0	47
Total	9	51	6	1	0	0	68

Table 2. Hydroacoustic pings analyzed, nautical area scattering coefficient (NASC), mean target strength (dB), and density estimates (number/ha) of Kokanee in each transect on Anderson Ranch Reservoir, 2012.

Reservoir Section	Transect Number	Number of Pings Analyzed	NASC	Mean Target Strength (-dB)	Kokanee Density (number/ha) Fry	Ages 1-3	TOTAL
Lower (1)	1	2,210	625.97	43.6	1,764	1,595	3,362
	2	1,658	986.82	42.9	1,909	2,555	4,467
	3	2,355	1395.85	42.0	1,934	3,215	5,168
	4	1,690	1273.68	41.7	1,704	2,683	4,412
	5	2,558	1713.69	41.2	1,982	3,249	5,270
	6	2,370	1633.55	40.8	1,819	2,670	4,540
	7	2,299	2503.46	40.3	2,088	4,032	6,217
Mid (2)	8	1,742	1276.34	40.7	1,493	1,970	3,513
	9	1,919	837.38	41.1	1,239	1,259	2,533
	10	1,886	398.17	42.7	1,125	568	1,712
	11	1,239	123.21	43.7	497	171	672
	12	1,870	172.04	39.8	177	177	379
	13	3,138	104.50	44.5	521	142	677

Table 3. Density and abundance estimates of Kokanee in Anderson Ranch Reservoir from a hydroacoustic survey in 2012.

Section (area)	Kokanee Age	Density (fish/ha) Estimate	90% CI (+/-)	Abundance Estimate	90% CI (+/-)
Lower (680 ha)	Fry	1,886	-	1,282,339	-
	Ages 1-3	2,857	-	1,942,766	-
	Total	4,743	-	3,225,105	-
Mid (590 ha)	Fry	842	-	496,919	-
	Ages 1-3	715	-	421,617	-
	Total	1,557	-	918,536	-
TOTAL (1,270 ha)	**Fry**	**1,401**	194	**1,779,258**	246,387
	Age 1	**1,862**	372	**2,364,383**	472,462
	TOTAL	**3,263**	535	**4,143,641**	679,787

Table 4. Kokanee abundance estimates for Anderson Ranch Reservoir, 2003 - 2012. Ages are putative.

Year	Age-0	Age-1	Age-2	Age-3	Age-4
2003	166,214	9,062	3,790	1,091	0
2004	-	-	-	-	-
2005	526,307	37,980	12,736	20,652	0
2006	1,186,580	192,890	40,528	9,827	0
2007	692,704	841,421	97,832	66,645	0
2008	1,172,086	40,712	152,748	30,584	0
2009	431,627	57,410	15,021	10,134	0
2010	786,879	45,215	137,352	44,507	3,335
2011	2,632,168	108,117	28,146	12,319	0
2012	6,357,038	1,199,423	111,074	4,203	0

Table 5. Rotenone application table for Anderson Ponds 1 and 2 treatments in 2012.

Rotenone Application Rates (2.5% Active)			
Carp in organic rich environment		8	ppm
Active rotenone		0.25	ppm
Ac-ft treated / 1 gal rotenone		0.38	ac-ft
Fishery	Pool	Measure	
Anderson Pond 1	Pool # 1	Ave. Width (m)	58
		Ave. Length (m)	80
		Ave. Depth (m)	0.30
		Volume (ha)	1.1
		Product needed (L)	3.9
	Pool #2	Width	60
		Length	48
		Depth	0.30
		Volume (ha)	0.7
		Product needed (L)	1.8
Anderson Pond 2	Pool # 1	Ave. Width	54
		Ave. Length	72
		Ave. Depth	0.30
		Volume (ha)	0.9
		Product needed (L)	2.4
	Pool #2	Width	72
		Length	91
		Depth	0.30
		Volume (ha)	0.3
		Product needed (L)	0.8
	Combined	Volume (ha)	3
		Product needed (L)	8.9

Table 6. Locations and structure descriptions for water distribution on the Hagerman WMA.

Location Description	UTM Location	Structure
Anderson 4 to Riley Impound	11Z 673527E 4737088N	18" culvert with slide gate
Anderson 3 to Anderson 4	11Z 673416E 4737333N	3' culvert w/boards
Anderson 3 to Riley Impound	11Z 673455E 4737356N	impassable with boards
Anderson 2 to Riley Impound	11Z 673542E 4737506N	impassable with boards
Anderson 1 to Riley Impound	11Z 673643E 4737583N	valve with slide gate
Goose Pond to Riley Impound	11Z 673709E 4737594N	impassable with boards
Goose Pond to Anderson 1	11Z 673707E 4737601N	bar gate & boards
E Bass Pond to Anderson 1	11Z 673503E 4737842N	stand pipe with boards
E Bass Pond to W Bass Pond	11Z 673484E 4737866N	stand pipe with boards
E Bass Pond to W Bass Pond	11Z 673455E 4737912N	bar gate
W Bass Pond to Anderson 1	11Z 673448E 4737828N	impassable with boards
W Bass Pond to Anderson 3	11Z 673318E 4738017N	stand pipe with boards
Anderson 1 to Anderson 3	11Z 673284E 4737993N	culvert with boards
Anderson 1 to Anderson 2	11Z 673284E 4737949N	94" boards
Highway	11Z 672728E 4738085N	cement box/culvert

Table 7. Standard bass sampling indices among Magic Valley Region fisheries from 2008 to 2012.

Fishery	Spp.	Measure	200	200	2007	2008	2009	2010	2011	201
Bell Rapids	LMB	Avg. catch (CPUE)	44		22	28	48			
		Avg. length (mm)	28		211	244	277			
		Avg length at Age 5	28		256	302	325			
		PSD	59		17	33	56			
		RSD(S-Q)	13		36	67	44			
		Max. age (years)	11		9	10	10			
Milner Res.	SMB	Avg. catch (CPUE)			63		76		92	
		Avg. length (mm)			198		200		202	
		Avg length at Age 5			315		264		273	
		PSD			28		26		39	
		RSD(S-Q)			72		74		61	
		Max. age (years)			9		11		15	
Salmon Falls	SMB	Avg. catch (CPUE)				240			128	
		Avg. length (mm)				185			168	
		Avg length at Age 5				220			226	
		PSD				33			21	
		RSD(S-Q)				67			79	
		Max. age (years)				7			9	
Lake Walcott	SMB	Avg. catch (CPUE)	99	92			124			150
		Avg. length (mm)	16	132			160			176
		Avg length at Age 5	42	418			387			331
		PSD	15	17			45			53
		RSD(S-Q)	85	83			55			47
		Max. age (years)	13	13			13			12
Magic	SMB	Avg. catch (CPUE)						2		42
		Avg. length (mm)						185		212
		Avg length at Age 5								284
		PSD						17		21
		RSD(S-Q)						83		79
		Max. age (years)						4		11

Table 8. Estimated densities of Rainbow Trout ≥ 200 mm by year and location in the Big Wood River.

Reach	Year	Season	Pop. est.	95% C.I.	Trout/100m	Trout/ha
Lower Hailey	1986	Summer	352	218-598	18	97
	1987	Summer	544	292-1,113	27	177
	1988	Summer	1,038	749-1,483	52	353
	1992	Fall	974	834-1,114	49	331
	1995	Fall	979	789-1,170	53	263
	1996	Fall	1,351	1,168-1,534	73	386
	2000	Fall	1,237	1,082-1,392	114	488
	2003	Fall	701	413-989	32	334
	2006	Fall	1327	951-1703	123	566
	2009	Fall	959	481-1437	81	470
	2012	Fall	1029	685-1237	102	534
Gimlet	1986	Summer	675	431-1,898	34	197
	1986	Fall	455	258-878	23	133
	1987	Summer	955	609-1,577	48	318
	1988	Summer	808	601-1,111	41	276
	1992	Fall	895	713-1,077	80	406
	1993	Fall	1,001	770-1,232	64	326
	1995	Fall	985	835-1,135	68	343
	1996	Fall	1,280	1,120-1,440	87	410
	2000	Fall	1,123	978-1,268	151	744
	2003	Fall	744	545-943	86	392
	2006	Fall	1198	971-1417	170	856
	2009	Fall	1166	743-1409	127	810
	2012	Fall	1003	873-1287	104	793
Boulder	1986	Summer	43	19-108	4	32
	1987	Summer	20	10-40	2	-
	1996	Fall	27	22-32	3	19
	2006	Fall	157	134-184	16	150
	2009	Fall	160	97-223	20	131
	2012	Fall				

APPENDIX A. Sample Locations

WATER	SITE	GEAR	UTM Coordinates E	N	ZONE	DATUM	NOTE
HAGERMAN WMA	Anderson Pnd 1	Rotenone	723481	4450386	11	WGS84	
HAGERMAN WMA	Anderson Pnd 2	Rotenone	723471	4450346	11	WGS84	
BIG WOOD RIVER	KENDALL GULCH START	E-FISHING	701628	4850386	11	WGS84	STR SURVEY
	KENDALL GULCH END	E-FISHING	702054	4850738	11	WGS84	STR SURVEY
	GIMLET START	E-FISHING	713877	4834706	11	WGS84	STR SURVEY
	GIMLET END	E-FISHING	714010	4833837	11	WGS84	STR SURVEY
	LOWER HAILEY START	E-FISHING	716791	4821341	11	WGS84	STR SURVEY
	LOWER HAILEY END	E-FISHING	716866	4821012	11	WGS84	STR SURVEY
LAKE WALCOTT	1	E-FISHING	671358	4745059	11	WGS84	SMB EVAL
LAKE WALCOTT	2	E-FISHING	670840	4744421	11	WGS84	SMB EVAL
LAKE WALCOTT	3	E-FISHING	668941	4740057	11	WGS84	SMB EVAL
LAKE WALCOTT	4	E-FISHING	668495	4738467	11	WGS84	SMB EVAL
LAKE WALCOTT	5	E-FISHING	669015	4737573	11	WGS84	SMB EVAL
LAKE WALCOTT	6	E-FISHING	669516	4736854	11	WGS84	SMB EVAL
LAKE WALCOTT	7	E-FISHING	670846	4743640	11	WGS84	SMB EVAL
LAKE WALCOTT	8	E-FISHING	669146	472710	11	WGS84	SMB EVAL
LAKE WALCOTT	9	E-FISHING	668661	4741951	11	WGS84	SMB EVAL
LAKE WALCOTT	10	E-FISHING	669283	4741080	11	WGS84	SMB EVAL
LAKE WALCOTT	11	E-FISHING	668939	4740645	11	WGS84	SMB EVAL
LAKE WALCOTT	12	E-FISHING	668317	4739774	11	WGS84	SMB EVAL
LAKE WALCOTT	13	E-FISHING	668499	4737952	11	WGS84	SMB EVAL
LAKE WALCOTT	14	E-FISHING	669048	4736726	11	WGS84	SMB EVAL
MAGIC RES	1	E-FISHING	713020	4796112	11	WGS84	SMB EVAL
MAGIC RES.	2	E-FISHING	711722	4797911	11	WGS84	SMB EVAL
MAGIC RES.	3	E-FISHING	710653	4799945	11	WGS84	SMB EVAL
MAGIC RES.	4	E-FISHING	713475	4794421	11	WGS84	SMB EVAL
MAGIC RES.	5	E-FISHING	711722	4797911	11	WGS84	SMB EVAL
MAGIC RES.	6	E-FISHING	710653	4799945	11	WGS84	SMB EVAL
MAGIC RES.	7	E-FISHING	713520	4796552	11	WGS84	SMB EVAL
MAGIC RES.	8	E-FISHING	710766	4800431	11	WGS84	SMB EVAL
MAGIC RES.	9	E-FISHING	711638	4796145	11	WGS84	SMB EVAL
MAGIC RES.	10	E-FISHING	711897	4798231	11	WGS84	SMB EVAL

APPENDIX B. Sampling Equipment

Fishery type	Equipment	Description
Mountain Lakes	Mountain lake gill net	Swedish made Lundgrens type-A lightweight multifilament sinking net
		6 panel (46, 38, 33, 30, 25, 19 mm bar-mesh) 45.6 X 1.5 m
	Scale	Pesola © : , 0-300 g, 0-1 kg, 0-2.5 kg scales
	Float tube	Creek Company© , round
	Conductivity meter	Yellow Springs Instrument (YSI) model 30
	Depth sounder	Hondex© portable depth sounder
	Secci disc	Standard; decimeter graduation
	pH meter	Oakton © hand held pH meter - Model 35624.2
Lakes & Reservoirs	Power boat electrofisher	Smith-root © model SR-18 w/ model 5.0 pulsator
	Boom	Aluminum (2.6 m-long)
	Anode	Octopus-style steel danglers (1 m-long)
	Cathode	Boat and cathode array danglers - simultaneous
	Live well	Fresh flow aerated; 0.65 m3
	Oxygen stone	35.6 X 3.8 cm (135 m2); fine pore
	Generator	Honda © ; model EG5000x; 5,000 watt
	Electrofishing control box	Midwest Lakes
	Sinking gillnet	6 panels (19, 25, 32, 38, 51, 64 mm bar-mesh); 38 x 1.8 m; monofilament
	Floating gillnet	6 panels (19, 25, 32, 38, 51, 64 mm bar-mesh); 38 x 1.8 m; monofilament
	Walleye Gillnet (FWIN)	8 panel (25, 38, 51, 64, 76, 102, 127, 152 mm bar-mesh); 61 x 1.8 m, monofilament
	Trap net	1.8 x 0.9 m box, 5 - 76 cm hoops, 15.2 m lead, 2 cm bar mesh
	Seine	18 m x 1 m, 6 mm mesh
		18 m x 1 m, 3 mm mesh
	Conductivity meter	Yellow Springs Instruments © (YSI); model 30
	Plankton nets	250, 500, 750 u mesh; 0.5 m diameter mouth; 2.5 m depth
	Temperature / D.O. meter	Yellow Springs Instruments © (YSI); model 550A
	Dip nets	2.4 m-long handles ; trapezoid heads (0.6 m2); 9.5 mm bar-mesh
	Secci disc	Standard; decimeter graduation
	Field PDA	Juniper Systems ©, model Allegro handheld; waterproof, WinCE/DOS compatible
	Scales	AND© 5000g electronic, OHAUS© 3000g, electronic
		Pesola © : , 300 g, 1 kg, 2.5 kg, 5.0 kg scales
Rivers and Streams	Power boat electrofisher	Smith-root © model SR-18 w/ model 5.0 pulsator - see above for specs.
	Outcast Power Drifter Raft	3.35 m
	Anode	13.7 m-long power cord; 2.4 m-long fiberglass handle; 0.4 m diameter steel hoop
	Cathode	Boat
	Live well	208 L plastic garbage can; O2 supplemented
	Drift boat	4.5 m-long aluminum
	Boom	4.3 m-long fiberglass
	Anode	Octopus-style steel danglers (1 m-long)
	Cathode	Boat
	Live well	208 L rubber stock watering tub; O2 supplemented
	Scales	AND© 5000g,electronic, OHAUS© 3000g,electronic
		Pesola © : , 300 g, 1 kg, 2.5 kg, 5.0 kg scales
	Oxygen stone	35.6 X 3.8 cm (135 m2); fine pore
	Generator	Honda © ; model EG5000x; 5,000 watt
	Electrofishing control box	Midwest Lakes
	Oxygen stone	35.6 X 3.8 cm (135 m2); fine pore
	Dip nets	2.4 m-long handles ; trapezoid heads (0.6 m2); 9.5 mm bar-mesh
	Backpack electrofisher	Smith-root © model 15-D; single anode
	Conductivity meter	Yellow Springs Instrument © (YSI) model 30

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